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ABSTRACT

This guide encourages a learning environment that allows for creativity. Creative theory, assessment, and talent identification information is given. Student activities are presented to encourage creative problem solving, dispel myths and misunderstandings about creativity, provide exercises in brainstorming, creative thinking, and making cross content connections. A section provides information on patents, trademarks, and copyrights. Reproducible student activity worksheets are included. (MM)

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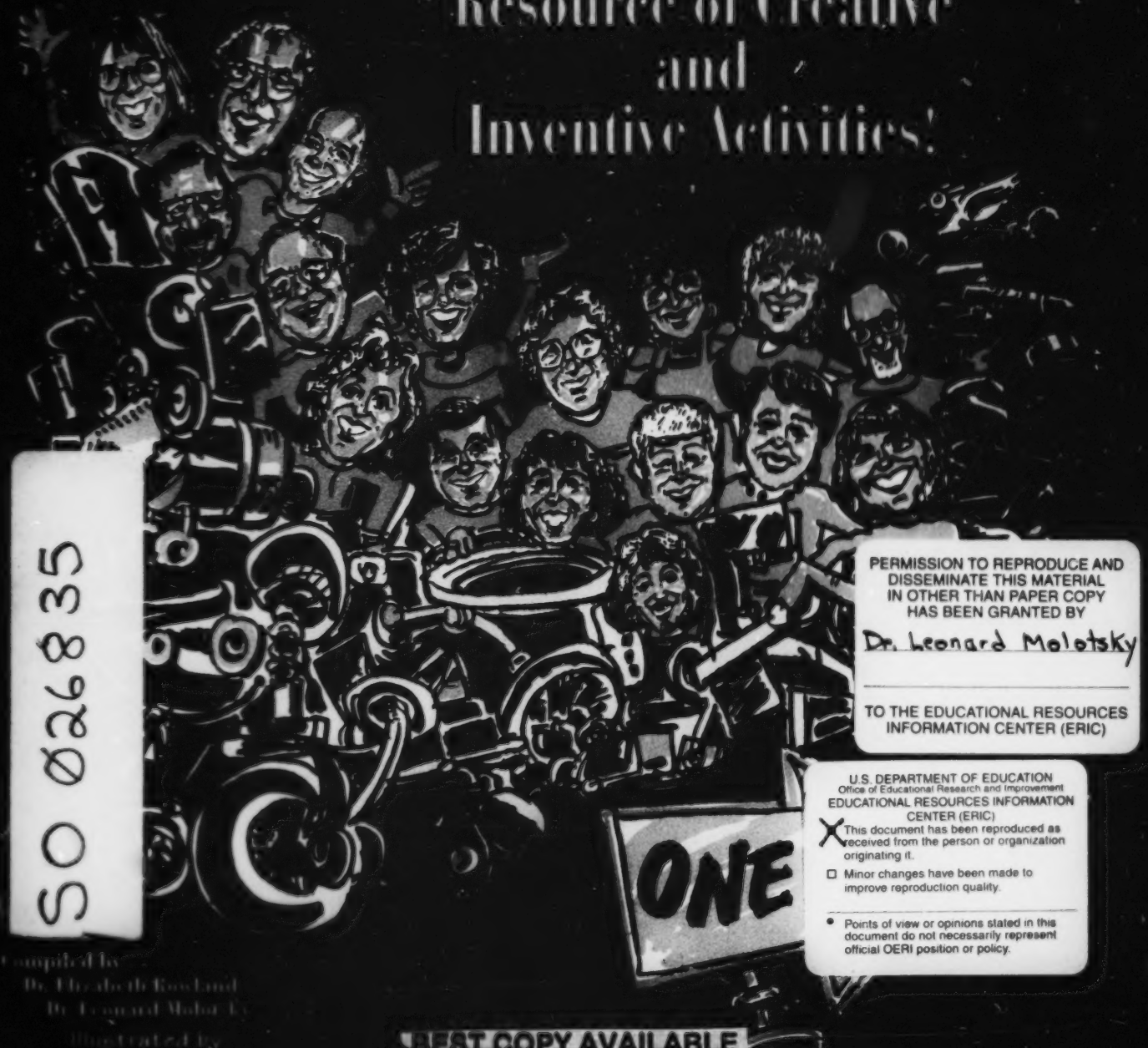
Resource of Creative and Inventive Activities!



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RESOURCE OF CREATIVE AND INVENTIVE ACTIVITIES

COMPLIED BY
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DR. LEONARD MOLOTSKY
ILLUSTRATED BY
JON PEARSON

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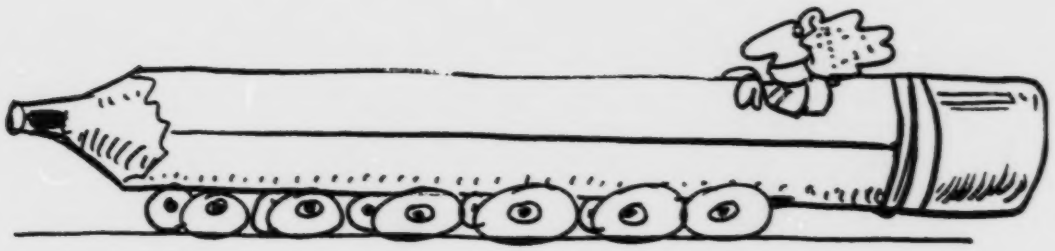

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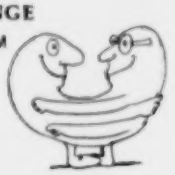

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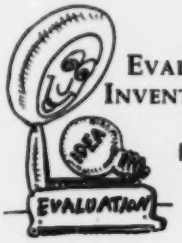

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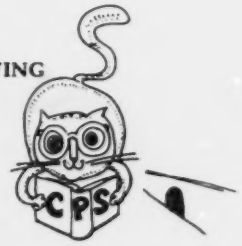

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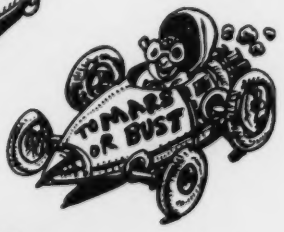

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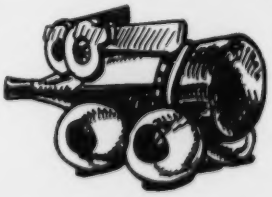
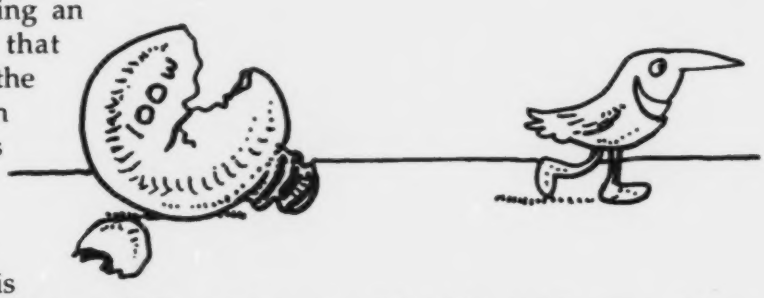


Preface

This book is dedicated to all those teachers who dare to risk—who dare to stretch— and by stretching themselves they dare to push their students. The boundaries of a student's potential are unknown. Perhaps unlimited. The boundaries of a student's potential often mimic the teacher's boundaries.

This book about inventive thinking is first of all about attitudes. Permitting the student to BECOME requires that the teacher permits herself and himself to BECOME. Perhaps we need to give ourselves permission to give our students permission. After all, we don't really "make" our students creative. We "allow" them to be creative.

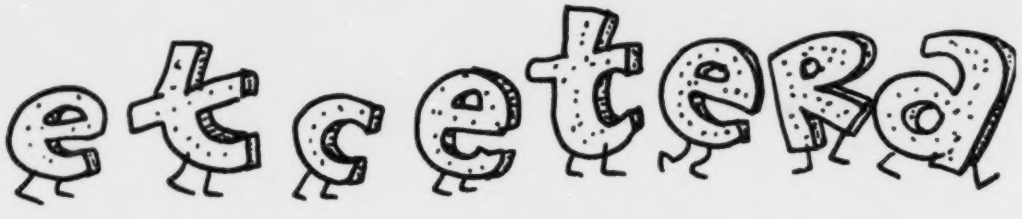


This book talks about setting an appropriate environment that allows for creativity. Once the individual's attitude is in synch and the ambiance is right, we can enhance our creative productivity by utilizing a few appropriate skills—tricks of the trade. This book talks about using some of those skills and about teaching (sharing?) some of those skills.

Once mastered, the skills usually cry out for some context—some information about creativity. This book is about creativity theory and assessment and identification. But most of all this book is about the attitudes and skills that make our students fully-functioning human beings.

This book, like teachers and students, is unfinished. The reader should feel free to select information and exercises from diverse locations to create new configurations. Not everything has been said about inventive thinking. We plan future editions, addenda and supplements. We have allowed for new ideas, additional refinements, newly invented activities, and issues not yet explored—at least not in this book. Like all teachers of creativity, we believe in ETCETERA. Feel free to add your own materials to this collection.

This book is dedicated to all those teachers who are committed to recognizing, nurturing, and celebrating student creativity. The National Inventive Thinking Association joins you in hoping that each student—from whatever personal history—will be encouraged to grow, to blossom, and, in turn, to nurture a new generation of inventive thinkers.

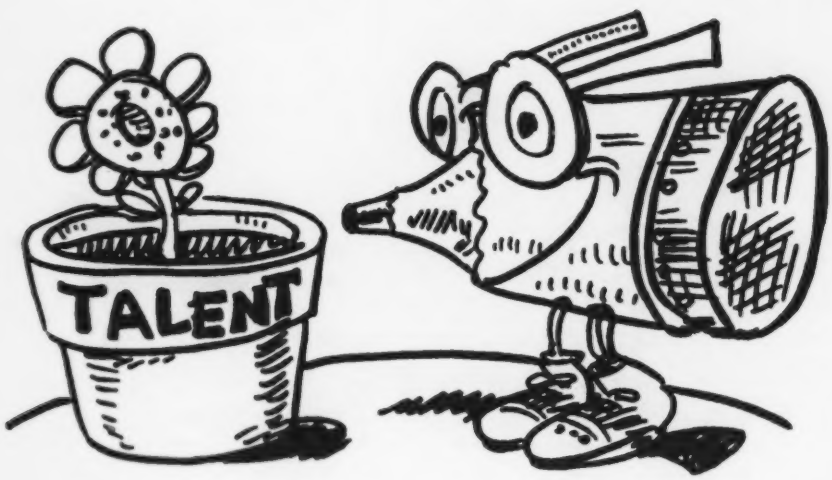


Recognizing, Nurturing, and Celebrating Talent Through Inventive Thinking

Grover Young

Grover Young

Grover Young teaches students, teachers, administrators, and parents. His specialty is creating opportunities for recognizing, nurturing and celebrating the unique strengths, talents, interests, and potentials of all students, staff and community members. He served as Gifted and Talented Program Coordinator for Holt Public Schools in Holt, Michigan for twenty-one years where he developed a comprehensive inventive thinking program. Grover is currently a consultant to school districts across the nation and an active member of NITA. He is an associate of the Center for Creative Learning in Sarasota, Florida.



Recognizing, Nurturing, and Celebrating Talent Through Inventive Thinking

Grover Young

"Only an inventor knows how to borrow,
and every man is or should be an inventor."
Ralph Waldo Emerson

This section deals with using inventive thinking programs and activities as a vehicle for talent identification and development. It is based on the concept that all students should be involved in real problem solving and creative thinking processes. A major premise is that teachers serve as facilitators and guides for the students in their classrooms by providing opportunities for students to develop and enhance their thinking skills. The ideas presented are linked to the provocative hands-on activities that are found throughout the book by specific tools for translating them into practice. The **Point Lookout Symbols** are provided in blackline master form at the end of the section. The ultimate goal is to help students become lifelong, independent, creative and critical thinkers and producers.

Talent Identification and Development

Inventive thinking activities and programs are a powerful vehicle for recognizing, nurturing and celebrating the unique strengths, talents, interests, and potentials of all students. Talent identification and development require teachers to take deliberate actions that have powerful effects upon all students.

Figure 1 depicts the process of talent identification and development as a cycle. A person might enter the cycle at any stage based on his or her observable performance, accomplishments or sustained interests. We might view the cyclical process as six stages involving different but deliberate actions, each of which is associated with a unique effect or result.

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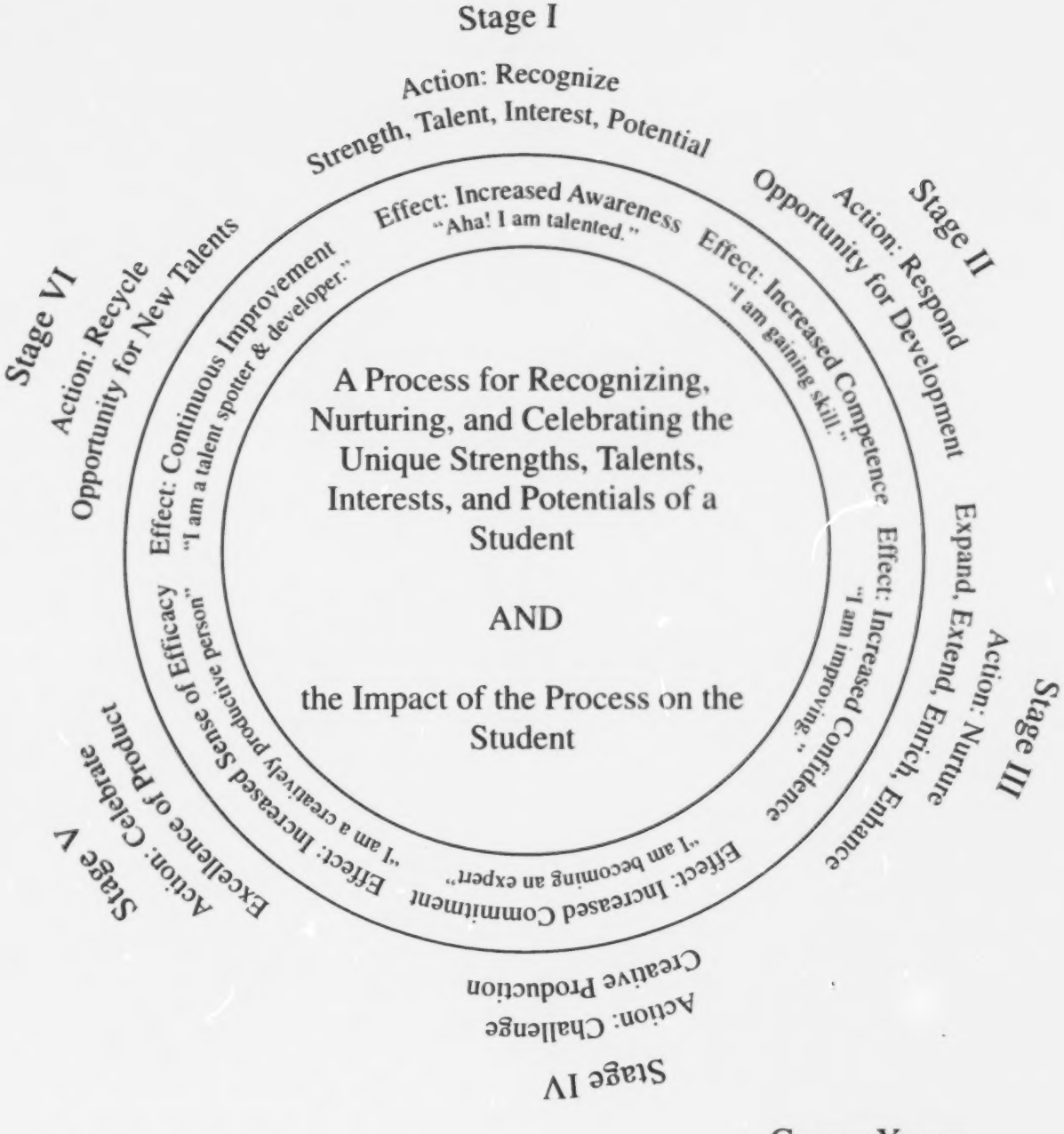


Grover Young
Holt, Michigan
1994

Figure 1

Stage I Action: Recognize. Create an opportunity for strengths, talents, interests, and potentials to emerge and be recognized.	Effect: Increased Awareness. "Aha! I am talented."
Stage II Action: Respond. Create an opportunity for development of this recognized characteristic.	Effect: Increased Competence. "I am gaining skill."
Stage III Action: Nurture. Create an opportunity designed to nurture the characteristic by expanding, extending, enriching, and enhancing the curriculum through breadth and depth of experiences.	Effect: Increased Confidence. "I am improving."
Stage IV Action: Challenge. Provide an opportunity for creative production.	Effect: Increased Commitment. "I am becoming an expert."
Stage V Action: Celebrate. Create an opportunity tocelebrate the excellence of the product.	Effect: Increased Sense of Efficacy. "I am a creatively productive person."
Stage VI Action: Recycle. Create an opportunity for new talents to be recognized.	Effect: Continuous Improvement. "I am a talent spotter and developer."

A successful experience in an invention program can have powerful effects upon all students and especially on those who might be considered "at risk." Many of the most outstanding students in invention programs would not necessarily be considered as outstanding academically in the classroom. For example, one student was considered a behavior problem until he had a successful experience in our invention program. Not only did his behavior toward others change as a result of his success with inventive thinking, but his academic performance also showed tremendous improvement. His talents and abilities were hidden until they were provided with an opportunity to emerge, be recognized, nurtured, and celebrated! In another case, a mother asked what in the world did I do to her daughter in order to get her to talk so easily. Apparently she was somewhat bashful until she had an opportunity to become an expert, create her own product, and communicate it to a real audience. Once again, hidden talents and abilities were allowed to emerge, be recognized, nurtured, and celebrated! The process described above makes it possible for students to acquire competence (knowledge and skill), confidence (attitude and awareness), and commitment (motivation and perseverance) - the 3 C's of creative production. As you implement the activities in this book you will be able to observe and document specific behaviors of students that indicate **competence, confidence, and commitment**. How you respond to these observations depends upon the unique combination of behaviors possessed by each individual and shown in **Figure 2** on the following page.

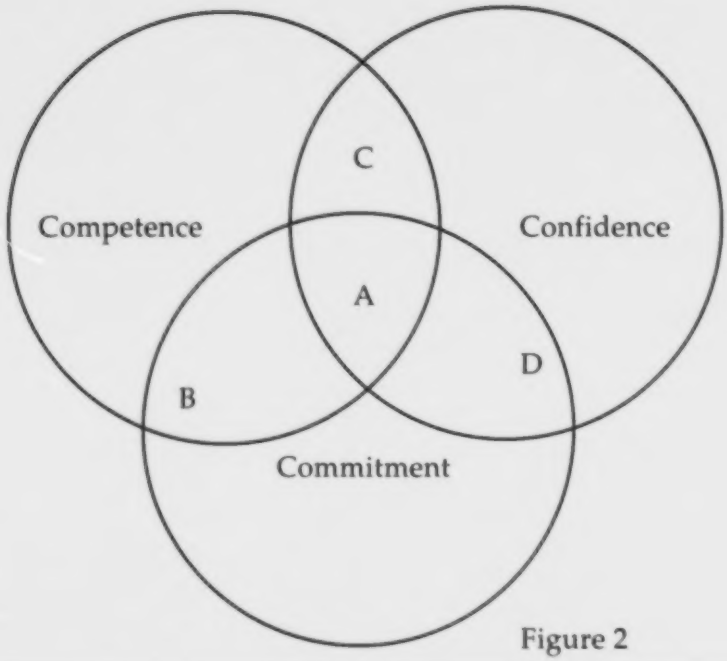


Figure 2

A = Student demonstrates comptence, confidence, and commitment.

B = Student demonstrates comptence and commitment, but lacks cofidence

C = Student demonstrates comptence and confidence, but lacks commitment.

D = Student demonstrates confidence and commitment but lacks competence.

Characteristics	**Response Strategies**
A Competence, Confidence, and Commitment	**CELEBRATION!**
B Competence and Commitment **but lacking Confidence**	Coaching and Nurturing
C Competence and Confidence **but lacking Commitment**	Motivational and Planning
D Confidence and Commitment **but lacking Competence**	Knowledge and Skill Building

For a more elaborate discussion of the factors involved in creative production and inventive thinking see the section entitled, "Exploring the Inventiveness In Everyone," by Donald Treffinger.

This book was prepared for the National Inventive Thinking Association, in conjunction with working sessions at the College of the Ozarks located in Point Lookout, Missouri in July of 1994. This unique college is fondly referred to as "Hard Work U" because all of it's students are involved in a work/study experience as part of their educational program. The College of the Ozarks is an outstanding example of an institution providing all students with an opportunity for recognizing, nurturing and celebrating their unique strengths, talents, interests and potentials. In recognition of the College's commitment to its mission artist, Jon Pearson and the author of this chapter created the Point Lookout Symbol.

Throughout this book watch for the Point Lookout Symbol. Suggestions for how to recognize and document specific competencies are offered whenever you see it. The following Point Lookout Talent Spotters are provided for record keeping convenience. These forms are tools designed to be used by teachers, students and work groups. They may easily be used to accompany a portfolio entry as documentation of specific competencies demonstrated by the student.

Point Lookout Talent Spotter #1

Principle: Inventors Demonstrate Openness and Courage

List names of students and evidence of:

1. Risk taking behaviors such as challenging assumptions, unafraid to make mistakes and going against the odds.

2. Positive thinking such as turning setbacks into opportunities or obstacles into challenges.

Point Lookout Talent Spotter #2

Principle: Inventors Observe Skillfully and Deeply

List names of students and evidence of:

1. Looking beyond the obvious or in new or different ways.

2. Curiosity, asking many and varied questions.

3. Perceiving gaps, paradoxes, needs or missing elements.

Point Lookout Talent Spotter #3

Principle: Inventors Acquire and Use Much Information Creatively

List names of students and evidence of:

1. Searching widely for information and ideas.
2. Seeking variety or breadth of experience.
3. Making connections that cross ordinary boundaries.

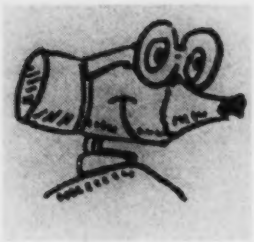
Point Lookout Talent Spotter #4

Principle: Inventors Know How To Generate and Analyze Possibilities

List names of students and evidence of:

1. Predicting, speculating, or forecasting.
2. Divergent thinking.
3. Using metaphors or analogies.

Point Lookout Talent Spotter #5



Principle: Inventors Know and Listen To Their "Inner Voice"

List names of students and evidence of:

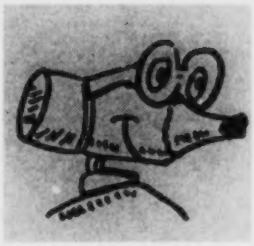
1. Having confidence and persistence for their ideas and goals.
2. Trusting their own hunches or intuitions.
3. Becoming absorbed in their passions.

Point Lookout Talent Spotter #6

Principle: Inventors Demonstrate Openness and Courage

1. In what ways do I demonstrate openness and courage?
2. How else might I demonstrate openness and courage?
3. I intend to work on....

Point Lookout Talent Spotter #7



Principle: Inventors Observe Skillfully and Deeply

1. In what ways do I observe skillfully and deeply?
2. How else might I observe skillfully and deeply?
3. I intend to work on....

Point Lookout Talent Spotter #8

Principle: Inventors Acquire and Use Much Information Creatively

1. In what ways do I acquire and use much information creatively?
2. How else might I acquire and use much information creatively?
3. I intend to work on....

Point Lookout Talent Spotter #9

Principle: Inventors Know How To Generate and Analyze Possibilities

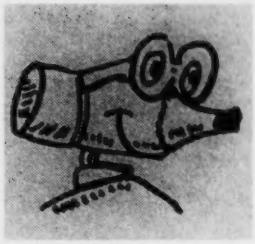
1. In what ways do I generate and analyze possibilities?
2. How else might I generate and analyze possibilities?
3. I intend to work on....

Point Lookout Talent Spotter #10

Principle: Inventors Know and Listen To Their "Inner Voice"

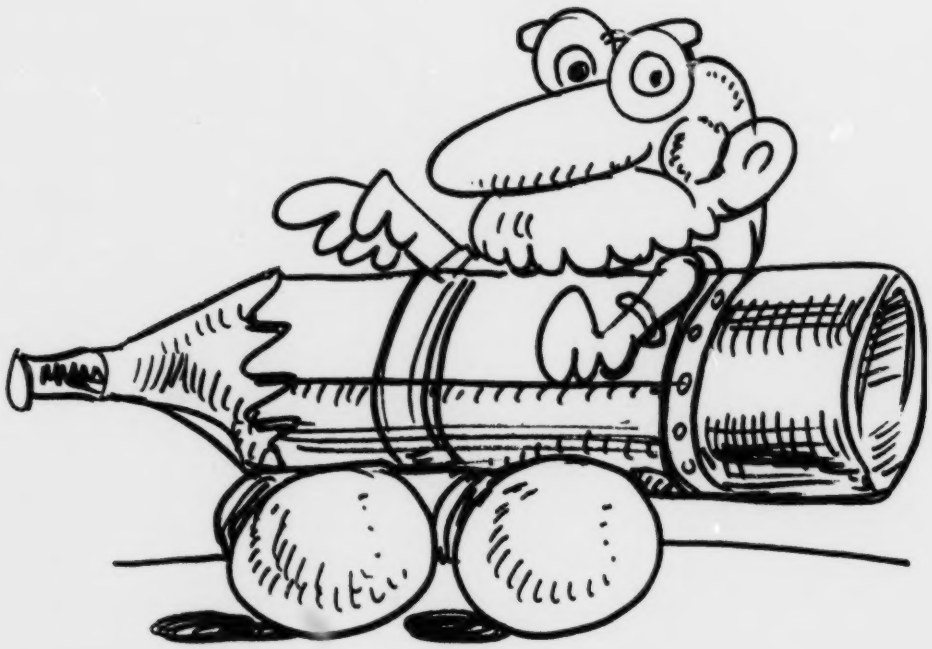
1. In what ways do I know and listen to my "inner voice" ?
2. How else might I know and listen to my "inner voice" ?
3. I intend to work on....

Point Lookout Talent Spotter #11



Principle: Inventors Engage in Continuous Improvement

1. How I feel about....
2. In my opinion, I.....
3. This activity demonstrates my.....

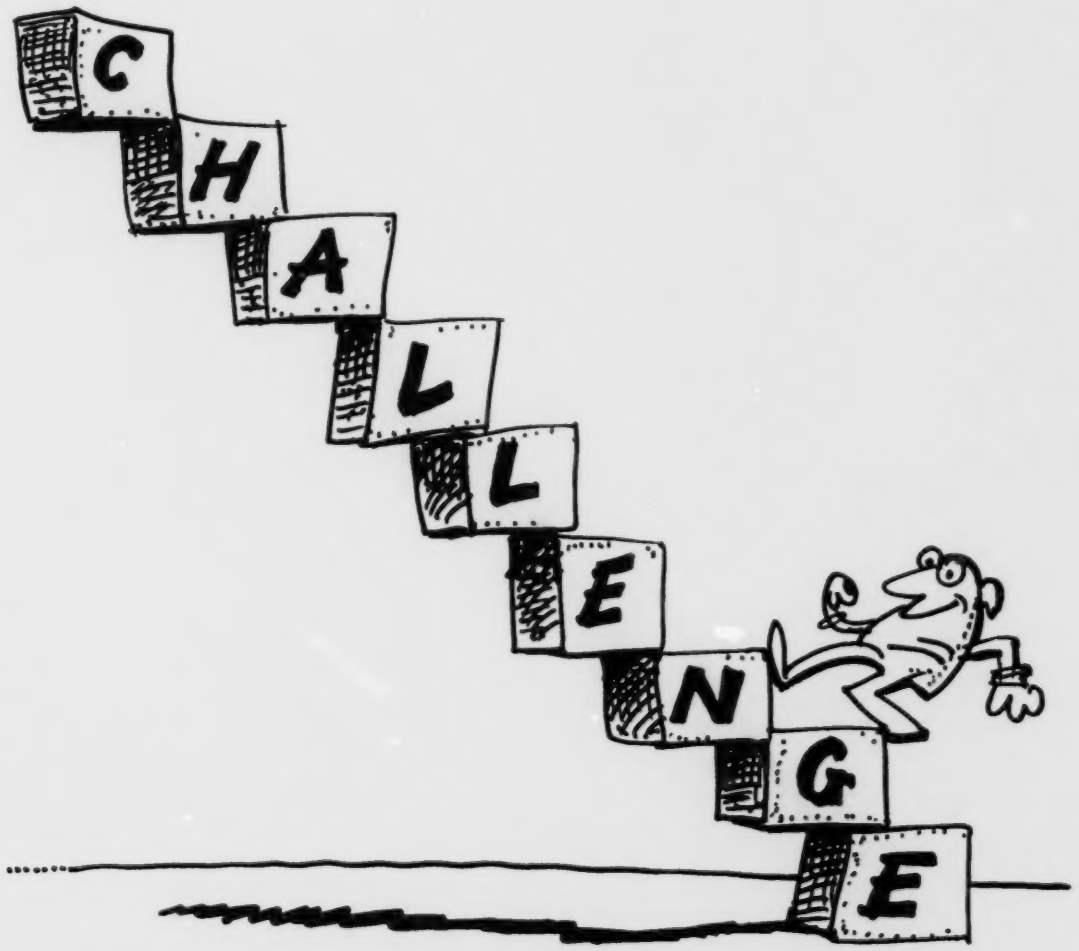


Accept the Challenge

Dr. Fred M. B. Amram

Dr. Fred M. B. Amram

Dr. Amram is currently Director of Academic Affairs of the General College, University of Minnesota. He is an award winning professor of speech communication and creativity and has authored books and articles relating to creativity, women inventors, robotics and communication. Professor Amram has been curator of several exhibitions displaying the achievements of women inventors. Thirty years of employment experience in industry and education has led to consulting activities on several continents.



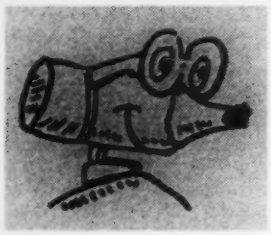
ACCEPT THE CHALLENGE

DR. FRED M. B. AMRAM

Here are one dozen activities to encourage creative problem solving. Each of the activities requires students to invent solutions to real problems that are presented in the context of history and culture.

Before the students are challenged with any of these problems, they should be encouraged to develop appropriate attitudes and should be exposed to creative problem solving skills such as problem-definition, idea generation techniques (such as "brainstorming"), decision-making, and implementation.

If the students are to work in groups, or if they will critique each other's inventions, they should first learn "Critiquing With Hugs"—described as follows.

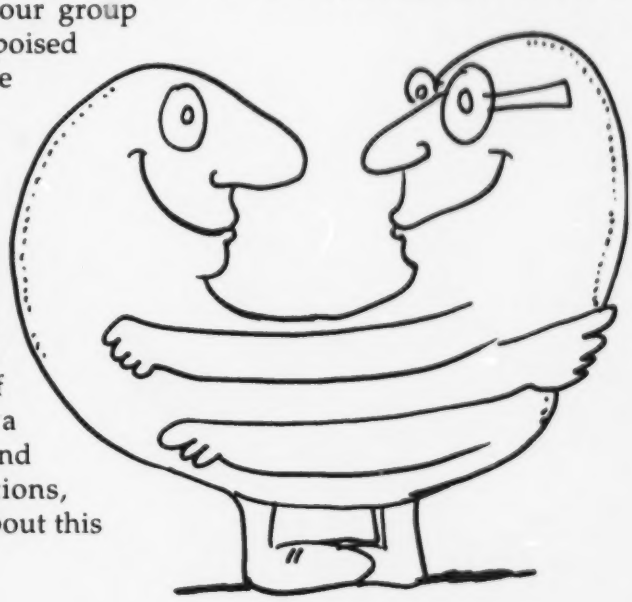


Use PLTS #11 with this activity in order to introduce the concept of positive and negative self-assessment.

CRITIQUING WITH HUGS

(Be kind to little fuzzy things. They might turn into butterflies.)

Giving criticism is always a difficult challenge. We avoid the truth because we don't want to hurt the other person's feelings. Or we use the "set 'em up for a fall" routine. "I like your idea, BUT...." Pretty soon our group partners, supervisors, or students are poised for the fall. They don't even listen to the first part of our sentence, and when they get home they only remember what came after the "BUT." George Prince in The Practice of Creativity (1972) offers a two-part alternative which he calls the Spectrum Policy. "BUT" is omitted from your critiquing vocabulary. Instead you begin with "I like your idea because...." Force yourself to find three reasons why you like a proposal. They should be honest and presented sincerely. All ideas, options, proposals have merit. What is good about this alternative?



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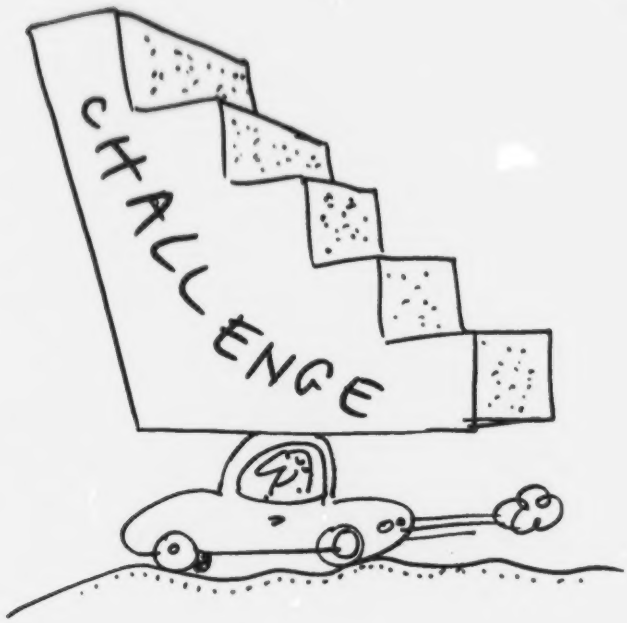
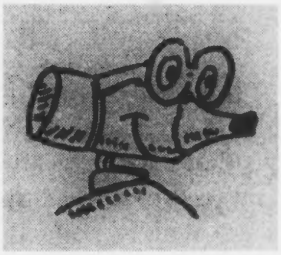
The second part recognizes that not all ideas are great and none are perfect. The person providing criticism expresses dissatisfactions as wishes which could come true. "I like your idea because...AND I wish that..." The sentence encourages the individual while suggesting that WE, with some extra work, might be able to repair imperfections.

Example #1
"Jim, I like your idea that we ask our teacher to take us on a field trip to the Invention Convention. Sending her a note via Federal Express, as you suggest, would make sure that she sees we're serious about the idea and would give her time to think about it. Having us all sign it would add power to the note. I wish we could find a way to assure that the note doesn't make our teacher angry. I also wish we could accomplish the goal with less expense."

Example #2
"Your idea to combine a hearing aid into an earring is splendid, Mary, because it would make the hearing aid less obtrusive. People who are embarrassed by their limited hearing could hide the `flaw' and decorate their ears at the same time. I also think that it is an inexpensive solution to an old problem. I wish that we could find a way to modify the earrings or transfer the hearing aid so that people wouldn't always have to wear the same decoration on their ears. In other words, I wish we could find an inexpensive way to allow women and men to have the benefit of many of your earring/hearing aids."



ACCEPT THE CHALLENGE



Use PLTS #2 with this activity in order to help identify students who observe skillfully and deeply.

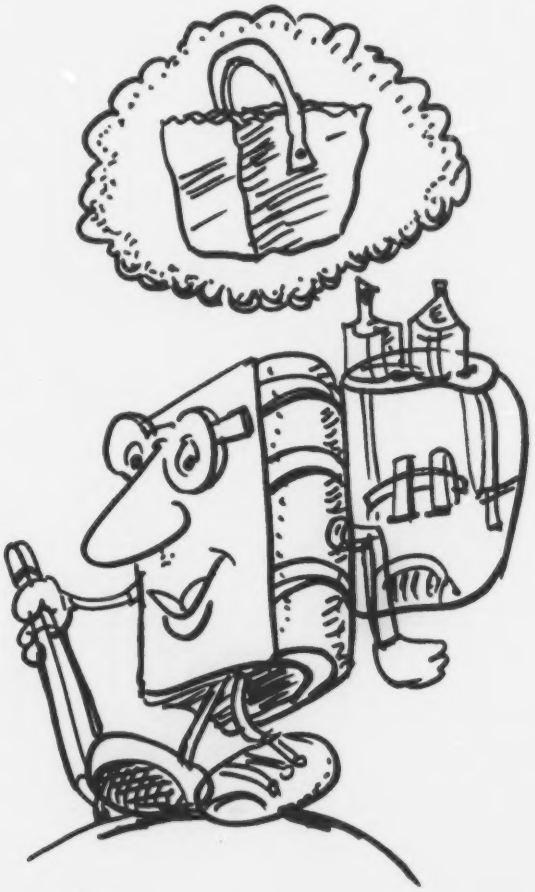
BACKGROUND

In the early part of the century, youngsters carried their books and school accessories in briefcases. The cases were often miniatures of adult versions designed to accommodate the smaller children, and were usually made of leather or simulated animal hides. Eventually straps were added to the briefcases so that youngsters could wear them on their backs, thus freeing the hands for play—or mischief.

The most recent evolution of "school bags" is the "book bag" fashioned like a mini-backpack. It can be worn on the back, but most frequently is thrown over one shoulder. Among its design problems is that it is neither comfortable nor stable on one shoulder. What other problems do you have with the modern book bag?

CHALLENGE

Design a comfortable, convenient, efficient storage and carrying device for students.



ACCEPT THE CHALLENGE

BACKGROUND

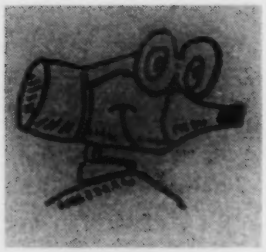
Portable sound systems have been popular since the invention of the radio. Portable radios in the '50s and '60s were small table models with handles added and were powered by large, often inefficient, batteries. The transistor, very small speakers and portable tape decks have created a whole new generation of portable sound systems (Walkman, et al.) which are becoming ever more popular. They are widely used by young and old—although some people disapprove for a variety of reasons.

The latest portable systems have seen much improvement with miniaturization, fashion shapes and colors, and attachments to clip the devices to belts and other clothing. What problems remain? How can these systems become even more useful, efficient and attractive?

CHALLENGE

Design the next stage in the evolution of portable sound.

ACCEPT THE CHALLENGE



Use PLTS #3 with this activity in order to help identify students who acquire and use much information creatively.

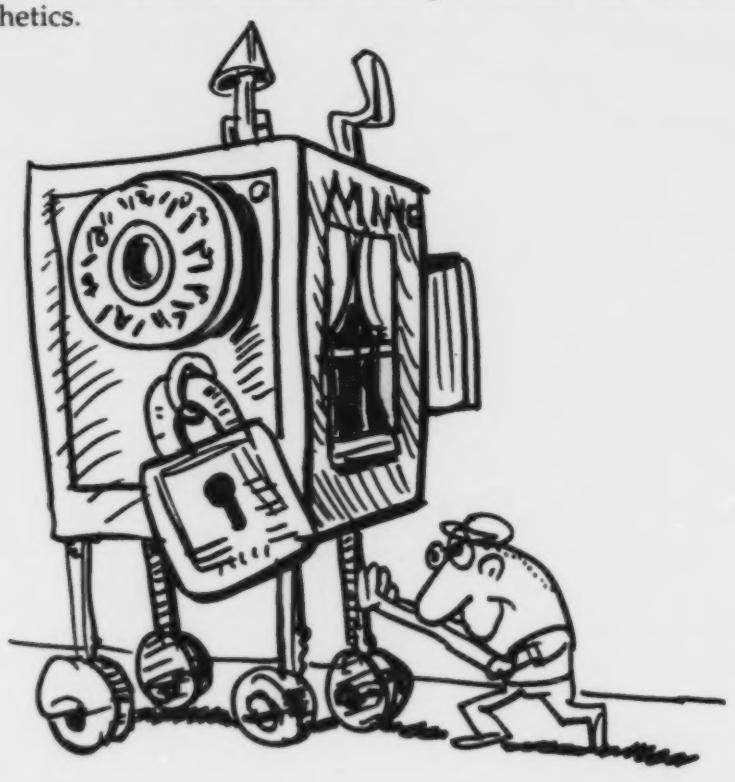
BACKGROUND

Lockers are used in factories and schools to store personal belongings including hats and coats, tools, books and papers, purses and sometimes "secret" items. Usually made of steel, their sharp edges and corners are sometimes dangerous. Slamming metal doors can be disconcerting. To fit into limited spaces, lockers have a history of rectangular shape, although smaller ones are sometimes square and placed in vertical stacks. External locks are occasionally lost.

Recent improvements include attractive colors, ventilated doors and convenient shelves. A few are now made from wood laminates. What problems have you encountered that make lockers less than perfect?

CHALLENGE

Design a new locker system to be used in schools. Incorporate user convenience, improved storage and aesthetics.



ACCEPT THE CHALLENGE

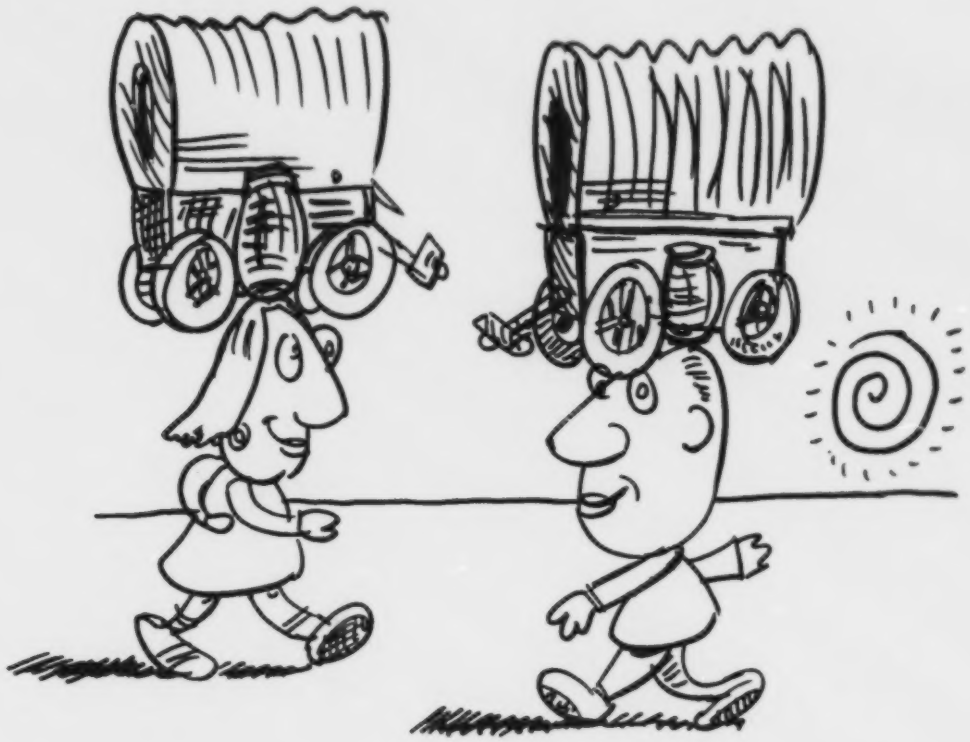
BACKGROUND

Duffle bags, backpacks, and suitcases are examples of storage devices used for travelers. Historically such containers have been soft covered (e.g., carpet bags) with sturdy handles sewn to the body. Early immigrants used trunks—flat topped for convenient stacking and round topped to prevent other trunks from crushing them. Materials have changed to reflect technology. Occasionally, internal compartments, straps, partitions, and clamps have been added to enhance user convenience.

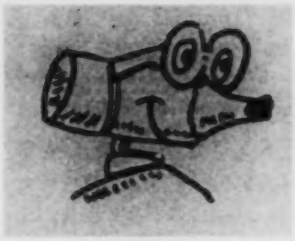
Recent improvements include "space age" external materials, recessed locks, wheels, as well as retractable handles and pulls. What problems remain for you and for other travelers?

CHALLENGE

Design an improved device for transporting limited quantities of items while traveling. Work to improve access, portability, protection and aesthetics.



ACCEPT THE CHALLENGE



Use PLTS #9 prior to this activity in order to teach about and students to self-assess their abilities to generate and analyze possibilities.

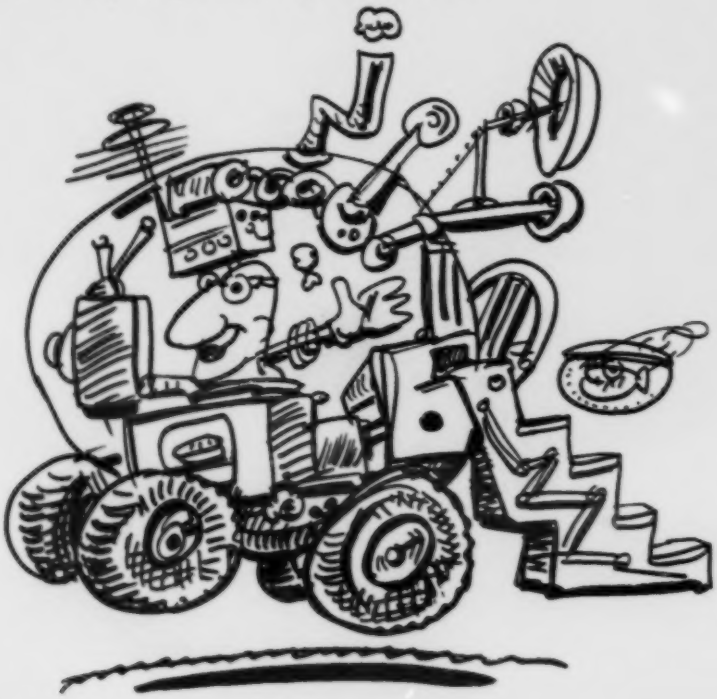
BACKGROUND

In the early days of American universities, students rented rooms from the proprietors of boarding houses or from University neighbors or professors interested in supplementing their income. Early fraternities (and subsequently sororities) imitated rented rooms by providing large desks, overstuffed easy chairs, and beds in a common house. The advent of dormitories brought about efforts to minimize costs and to conserve space. The double or triple dorm room became more popular.

Recent innovations in college dorm rooms introduced bunk beds, under-bed storage, mini-desks, stacking chairs, and built-in book shelves. Yet the dorm room remains uncomfortable for those planning to spend nine months or more in the same room. As a potential user, what problems do you anticipate in the dorm space's resistance to adapt to individualized needs and tastes?

CHALLENGE

Invent a furnished room for 21st-century student housing. Consider safety, aesthetics, adaptability to scholarship, costs, and "quality of life."



ACCEPT THE CHALLENGE

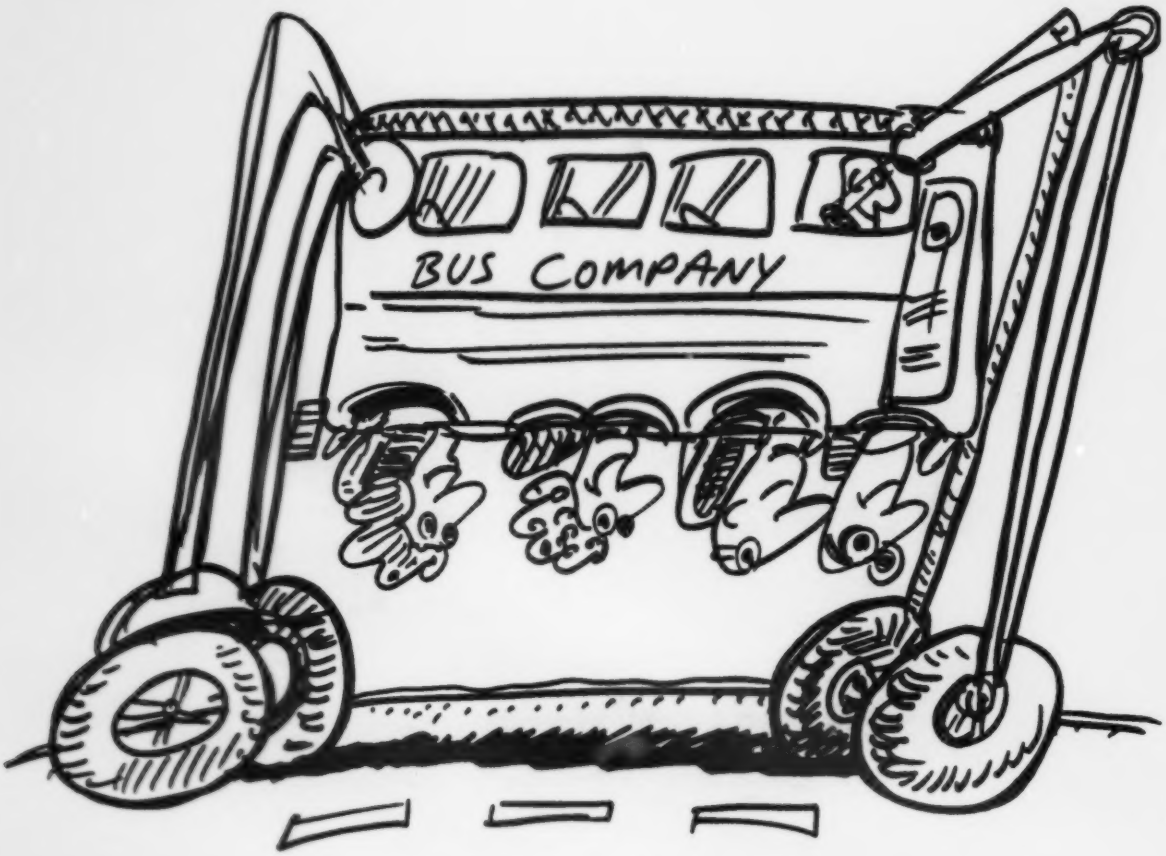
BACKGROUND

Early wagons, propelled by horse power, transported people on wooden benches. Stagecoaches provided better protection, limited spring systems for comfort and moderately upholstered seats. Streetcars and buses imitated wagons, although the means of propulsion varied. Center aisles improved access to rear seats, making longer coaches possible. Improved springs, upholstery, decor and lighting made a trip somewhat more pleasant.

Recent bus interior improvements include air conditioning, bathrooms for long trips, enhanced overhead storage, and better sound insulation. Yet buses (as well as subways and trains) offer only modest comfort and extended trips are barely tolerable. What dissatisfactions have you experienced with buses?

CHALLENGE

While ignoring alternative methods of propulsion, invent an improved seating system for buses. Consider quality of air, personal comfort, safety, aesthetics and such other issues as you deem important.



ACCEPT THE CHALLENGE

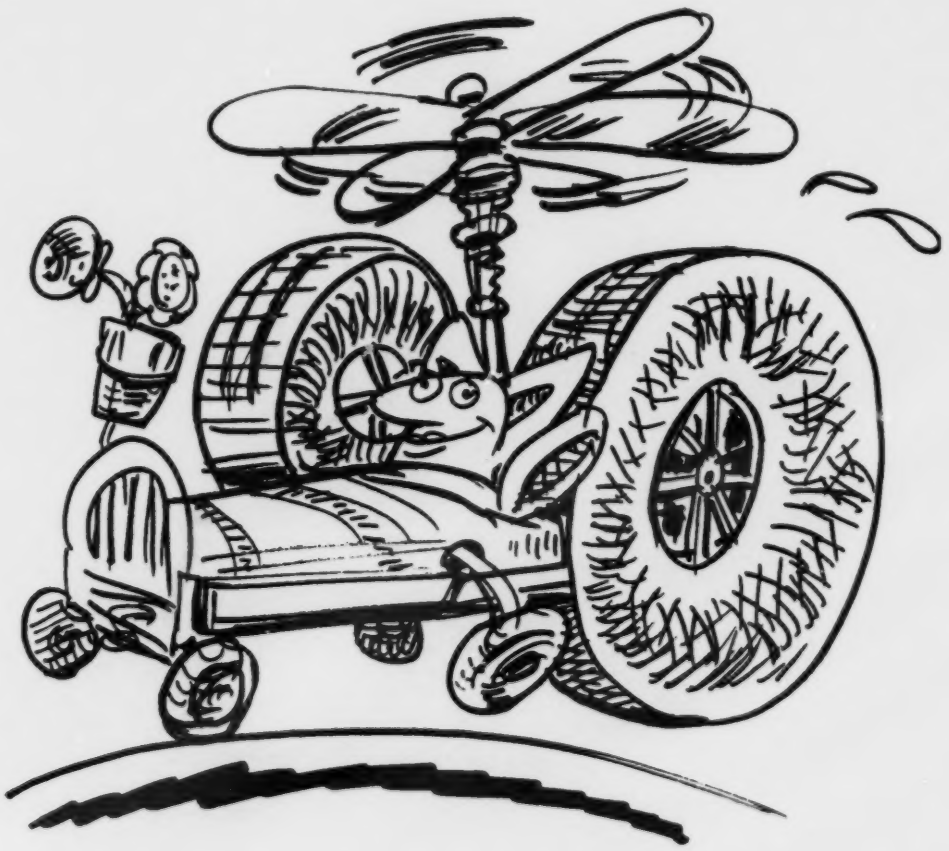
BACKGROUND

Wheelchairs, in the 19th century, were large wooden chairs with cane seats. Wheel diameters often measured three feet and, because they were made of bent wood, wheels frequently were not quite round. The chairs were too bulky for self-propulsion, but had a large handle at the rear for pushing. Their size prohibited much indoor maneuvering.

Recent innovations include smaller size, less weight, wheel rims for personal propulsion, sling chairs for greater comfort and easy folding for compact portability. Yet wheelchairs are not useful for steps and curbs, work poorly in snow and have limitations on inclines. What additional wheelchair problems have you observed?

CHALLENGE

While a perfect wheelchair may not be possible, you are asked to design an improved model. Consider convenience for the user, portability in vehicles, maneuverability, aesthetics and other issues which might be important to a person with impaired mobility.



ACCEPT THE CHALLENGE

BACKGROUND

Airline food has become a national joke. Quality and quantity have been debated. Interestingly, another concern to airlines and to ecology groups is the waste related to airline food service. The federal government, in an effort to provide maximum health protection, forbids the reuse of most airline food. For example, all food on a tray, if not consumed, must be thrown away once that tray has been unwrapped. All food heated, whether unwrapped or not, must be thrown away if not eaten.

A typical dinner tray includes meat, vegetable, pasta or potato, salad, dessert, butter and roll or bread. If, for example, the roll, butter and dessert are not eaten by a dieter, those items will become garbage. The amount of such food waste is drawing national concern. What additional food service problems have you experienced?

CHALLENGE

Devise an improved food service system for airlines which adheres to federal health standards, does not significantly increase airline costs and minimizes food waste. Consider issues related to distribution and collection time, passenger comfort, safety and aesthetics.

ACCEPT THE CHALLENGE

BACKGROUND

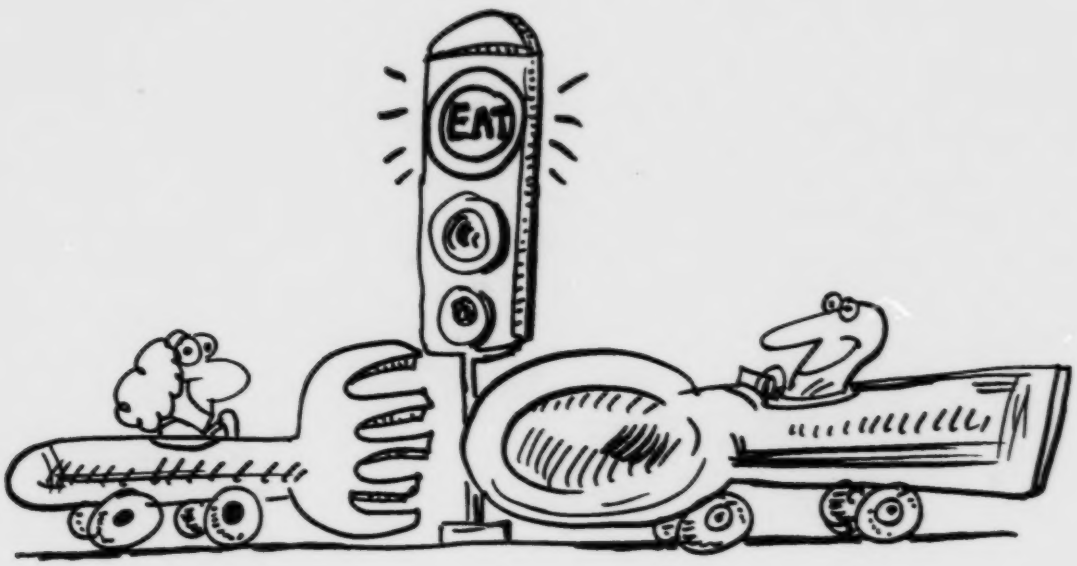
Historically, eating has reflected both cultural norms and technological developments. Eating with the hands and cutting with the teeth was the norm in most of the world. In the West, sharp-edged stones tied to wood handles developed into knives. Spears became holding devices and were improved into two-tined spears (forks) and eventually into three-tined or four-tined forks. Preferred materials have ranged from iron to silver (silverware) to pewter to gold to plastic. The aesthetics of flatware has become an art form, used to reflect status.

In Asia the spoon is much more important as a serving device and, of course, chopsticks lift food to the mouth. The fork is little used except as a Western affectation. Some cultures prefer to eat with the hand. Some Malays and Tamil Indians give theological significance to eating with the right hand, while eating with the left hand is taboo.

In the West we take our flatware (knives, forks, spoons) for granted. The last half century has seen little improvement, although our Western eating tools are far from perfect. What problems can you identify for the typical user? What problems can you see for the special user?

CHALLENGE

Invent new eating tools to reflect modern Western diets. Identify problems with existing tools, and keep in mind such issues as cost, safety, aesthetics, efficiency and comfort.



ACCEPT THE CHALLENGE

BACKGROUND

Early foot coverings were made of animal skins. Because shoe structure and sizing had not been developed, these "shoes" were simply wrapped around the foot. Eventually tops were separated from bottoms and tied together—much like modern moccasins. Soon that technology led to using different materials for shoe tops and bottoms. Learning to tie parts of the foot covering together also made for greater comfort and better fit. New materials and new ways of treating old materials made shoes sturdier and more adaptable to diverse uses.

Recent innovations, particularly in sneakers, provide for special arch, heel and ankle supports. Velcro has allowed some manufacturers to replace laces. Inexpensive materials and excellent dyes have called attention to footwear aesthetics. Yet problems exist with today's footwear. Can you identify additional footwear problems?

CHALLENGE

Design new footwear useful for going to classes, shopping or other minimal-impact walking activities. Consider issues related to comfort, safety, cost, aesthetics and ecology. Your invention may be the beginning of a new and exciting fad!

ACCEPT THE CHALLENGE

BACKGROUND

Traditionally color has been applied to surfaces in three general ways. First, items have been dipped in liquid color solutions to impregnate the material. Variations on this dying process protect parts of the surface from the color by using wax, presses or tying off parts of the surface (tie-dying).

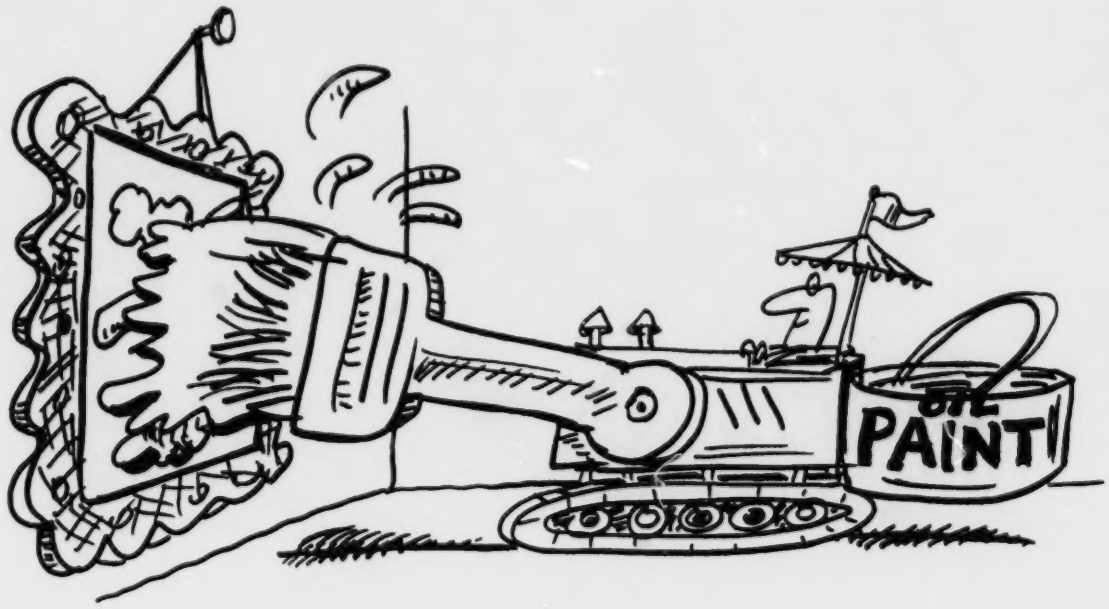
A second technique for "coloring" uses a tool to apply the color. Most typically a paintbrush made of natural or artificial bristles holds the color, which is then applied to a surface. Artists have devised many variations on the brush by adapting size, shape and materials (e.g., rollers). Crayons are a non-liquid variation on this technique.

Third, modern technology offers techniques for "blowing" paint onto surfaces. "Airbrushing" has made some amazing effects possible.

Why do people continue to invent new ways of applying color to surfaces?

CHALLENGE

Invent a new technique for applying color to surfaces for use by artists or the construction industry. What problems does your invention solve? What new opportunities does it create? Consider issues related to safety, aesthetics, cost and wear.



ACCEPT THE CHALLENGE

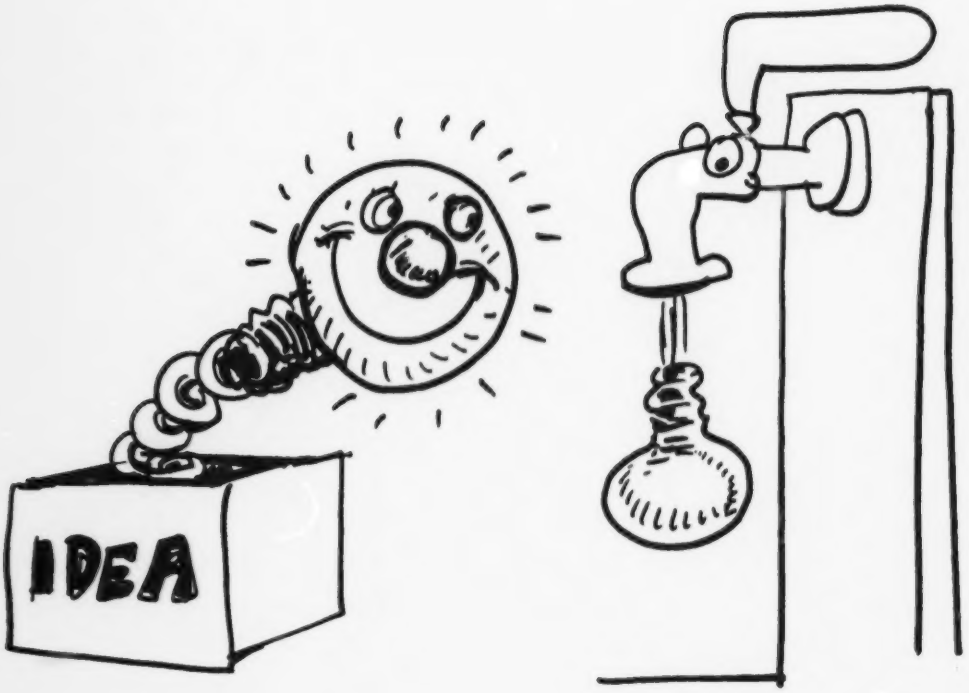
BACKGROUND

Traditionally people in northern climates own several sets of clothing. Winter and summer wear varies in material used, material weight, color and amount of the body covered by the clothing. While accessories (ties, jewelry) can be used during diverse seasons, the main costume is limited to specific weather periods.

Clearly, more traditional materials such as fur, wool and linen are seasonal, although newer inventions (e.g., rayon) have made clothing somewhat more flexible. Furthermore, indoor temperature control has alleviated some of the extreme needs for clothing adaptation. Nevertheless, clothing is still fairly restricted and requires extra cost to purchase wardrobes for multiple seasons. What additional problems have you experienced with clothing?

CHALLENGE

Design an article of clothing (or several related items) that can be used during all seasons, or which can be adapted to different weather conditions. In this project we're interested in major clothing items rather than accessories. Consider such factors as flexibility, cultural acceptance, cost, aesthetics and ecology. You may be creating a grand new fad!



37

Exploring the Inventiveness in Everyone

Dr. Donald J. Treffinger

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Dr. Treffinger is President of the Center for Creative Learning in Sarasota, Florida and Professor of Creative Studies at Buffalo State College in Buffalo, New York. He is an educational psychologist who has long been interested in recognizing and nurturing creativity and creative problem solving among children and adults. He has been a teacher at the elementary and middle school levels, and a faculty member at Purdue University and the University of Kansas. Dr. Treffinger is the author or co-author of more than 200 published articles, monographs and books on creative learning and problem solving. He is a member of the Educational Advisor panel of Inventure Place (Home of the National Inventors Hall of Fame) and the educational advisory board of the National Inventive Thinking Association.

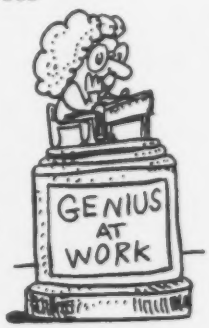
Exploring the Inventiveness in Everyone

Dr. Donald J. Treffinger

The terms creative and creativity seem to mean something different to almost everyone who uses them. They are used and misused so much, and so often, that they have become for many people mere "buzz words" of very little importance—and often, words that suggest foolishness or chicanery. There are many myths and misunderstandings about creativity, in any of its manifestations. Many of those myths carry over to inventing, which might be described as a *process* that takes place when creativity is brought to bear on a need or opportunity to do something new, better, or differently in any applied field.

Let us look briefly at three of these common myths.

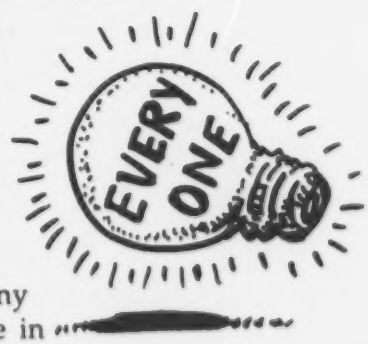
1. Creativity or inventiveness are mysterious experiences that just "appear out of the blue sky."



2. Inventors, like most other kinds of creative people, are a rare group—a few special geniuses endowed with a gift that was not given to most mere mortals. Like other highly creative types, inventors are eccentric, odd, socially inept, "flaky" or maybe even bizarre, and right out there near the edge. Inventors are odd, and they are born, not made.

3. The process of inventing is necessarily mystical, defining rational description, predictability, or nurture. You can't really say how to do it, and in fact, if you try too hard to study or control or manage it, it might vanish entirely.

If these were truths, rather than myths, we might hold some very specific expectations about how researchers and practitioners should approach or deal with the topic of creativity. In some ways, in fact, looking to the literature of the field reveals that theory and research have often appeared to treat these myths as if they were credible.



If these myths were truths, for example, it would seem to be reasonable to attempt to distinguish the characteristics or traits of a few rare geniuses who are successful, creative inventors from other more ordinary people. In fact, many studies of the creative personality approached the issue in

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exactly that way, from the 1950's well into the 1970's and 80's. Many researchers went on a search for the characteristics of definable groups or categories of interesting and presumably unusual people: inventors, creative artists, scientists or managers; gifted people. They wanted to find out the difference between those who were "really" or highly creative, and those who were not.

It has been a merry, if frustrating chase. It is not that the research did not reveal some interesting characteristics—which were subsequently formulated into many impressive check lists and rating scales—but rather that researchers and practitioners have nearly drowned in all the characteristics that have been described. In an informal, unpublished search several years ago, we combed the literature in search of as many "creative characteristics" as we could possibly find. The list numbered more than 300, and we stopped there—more because we ran out of the will to keep listing than because we were certain we had exhausted the possibilities. (And, no, the list is not available for anyone to use in making up the biggest, grandest identification check list yet. We fear the consequences: "Whoa! You only have 235 of these characteristics—sorry Mr. Edison, you'll never be a creative inventor.")

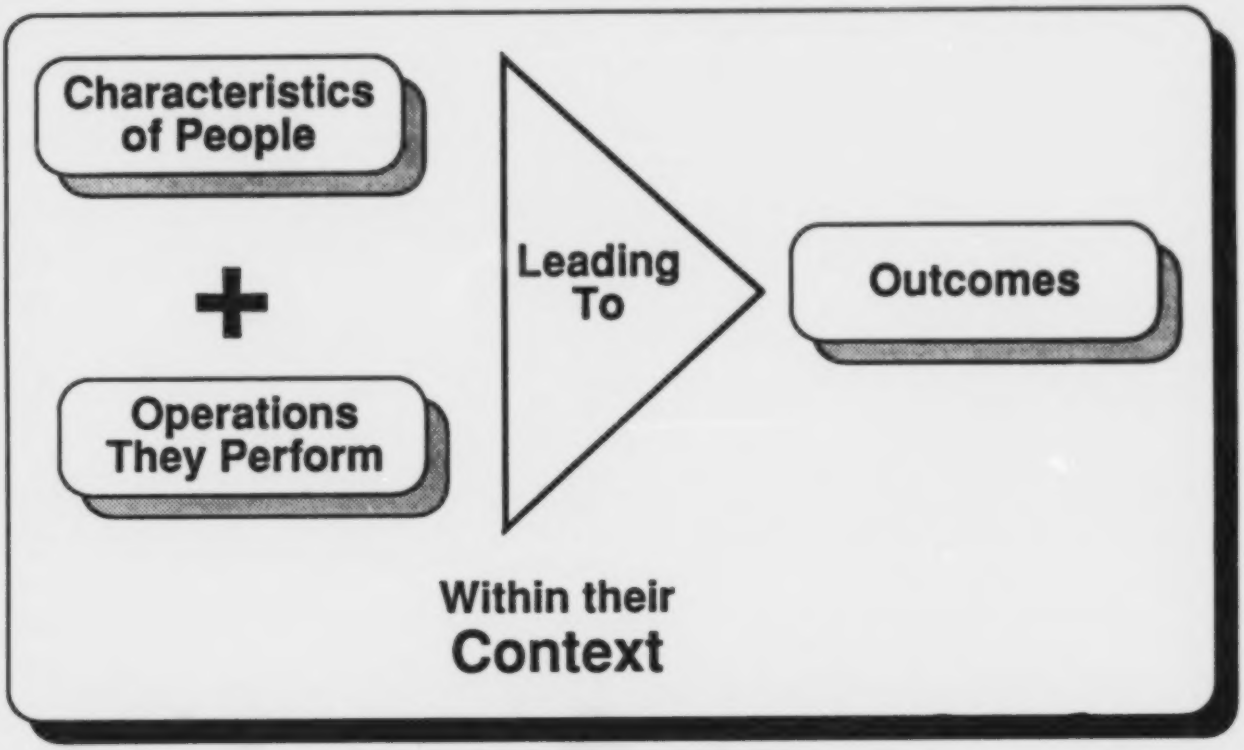
Even more interesting than the sheer quantity of characteristics, however, was their nature and variety. It would be simply impossible for any human to possess all of the traits or qualities that turned up on our list. With apologies to Clark Kent, just about the only items we did not find were, "Walks on water" or "Leaps tall buildings with a single bound." Many of the items were contradictory—so inherently opposite that one could not possibly be both. Some researchers were quite clever in resolving that concern; they included, "deals effectively with tensions, disharmony and paradoxes."

With the increase in attention to learning styles in education in the mid- to late-70s (e.g., Dunn & Dunn, 1972, 1978), some creativity researchers were intrigued. Perhaps these newly-emerging tools would help us better to understand the differences between more and less creative people. Alas, more frustration: no single learning style pattern seemed to characterize adequately all creatively productive people.

Since then there has been considerable new progress in research, which has been facilitated greatly by a new way of thinking about the challenge. The turning point has really been the conclusion that we had not been asking the right question. This has opened the door for a number of very new and different research pathways. Most simply put, we learned that instead of asking, "How creative are you?" it would be much more productive for us to ask, "How are you creative?" Although this seems very simple, and looks on the surface only to be a little semantic sleight of hand, its consequences and benefits have been substantial. It may yet, in the

long term, prove to be the most significant new finding about creativity of our generation of scholarship in the field, and it might not be too bold to suggest that, in fact, it can be the cornerstone of a very substantial paradigm shift. The basic form of that paradigm shift holds up quite well across almost any talent or ability domains with which we have tested it. That is, it seems just as plausible in relation to giftedness (from "How gifted are you" to "How are you gifted"); any talent area, or a specific domain of applied creativity (from "How inventive are you" to "How are you inventive").

Creative productivity, such as inventiveness, is best viewed, not merely as a set of "hard-wired" traits within the mind or personality of the individual, but as a composite of many factors that are in constant, dynamic interaction. This challenge has been discussed in the literature in relation to proposals for an "ecological" view of creativity (e.g., Harrington, 1990; Isaksen, Puccio, & Treffinger, 1993). Consider, for example, the interaction among four constellations, keeping in mind the brief acronym, COCO. These are portrayed in below (from Treffinger, 1994).

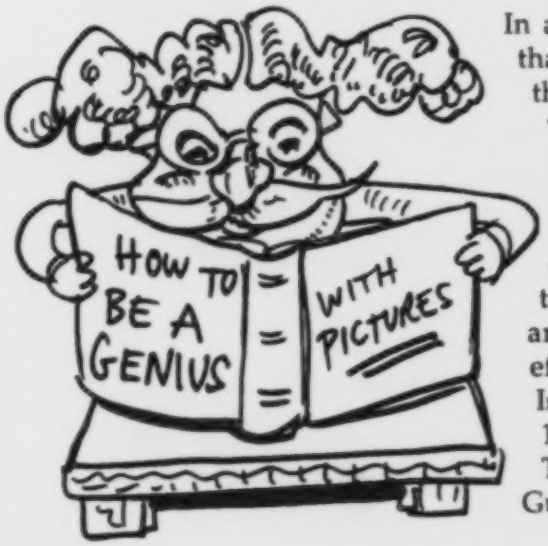


COCO: Components of Creative Productivity
Source: Treffinger (1994); reproduced by permission.

Each of the four components of the COCO model can help us to discover ways to set aside one or more of the myths, and to explore the potentials for inventiveness and creativity in everyone.

- **Characteristics.** Rather than viewing characteristics as limiting traits or qualifications, we might instead view them as ways to understand and manage diagnostics: gaining better knowledge of one's strengths, interests, styles and personality to enable someone (teacher, mentor, supervisor, person for oneself) to focus, guide and direct inventive efforts and energies productively. That is, we should look at characteristics as one source of information to help us understand people and to guide us in helping them learn and grow, not just as a means of sorting them into groups or categories. Viewed in this way, the potential for meaningful creative productivity and inventing is not just the province of a few isolated geniuses. It is within everyone. This does not mean everyone is (or even will necessarily become) creatively productive, or a successful inventor. It does mean, however, that ***anyone might!*** In addition, not everyone will be creative or inventive in the same way or in the same domain. Knowledge of individuality and learning styles suggests that creativity and inventiveness can be expressed in a variety of ways and applied in a very extensive array of talent domains (Dunn, Dunn & Treffinger, 1992; Feldhusen, 1992; Gardner, 1983; Kirton, 1976).

- **Operations.** For years, there has been heated debate about the question, "Can we teach creativity?" In the old paradigm, this was an elusive and challenging question, primarily because it was often addressed at the level of seeking "deep core changes in the inner make-up of the person." If only a few people really had the traits and abilities of creativity, then anyone who purported to be teaching creativity was boldly asserting that they could modify and change the deepest, inner workings of the person... putting something in that was not there before.



In a more contemporary, ecological view, that issue has lost much of its vigor. Today, the question might better be stated as, "Can we help people increase or enhance their ability to think creatively and critically, to solve problems and to make decisions?" There is ample research to support the view that deliberate efforts to enhance creative and critical thinking and Creative Problem Solving can be effective and powerful (e.g., Isaksen, 1987; Isaksen, Murdock, Firestien, & Treffinger, 1993a, 1993b; Torrance, 1972, 1987; Treffinger, Sortore, & Cross, 1993; Van Gundy, 1987).

A person's creative productivity does not depend only on some fixed set of internal personality traits or level of cognitive abilities; it also reflects the extent to which the person knows and uses effective strategies appropriately. To do so, one must be *competent* (knowing the strategies, when and how to use them, and monitoring the results), *confident* (aware of one's ability to use the strategies successfully) and *committed* (willing to engage in using them).

- **Context.** The setting and environment in which one functions, and one's reactions to that context, also work to encourage or inhibit creativity and inventiveness. Creative characteristics and a rich array of strategies can be the foundation for success in one setting, at a certain time and in relation to a task or goal, or they can be a design for frustration, lack of productivity, and disengagement in unsupportive environments and situations. Effective problem solving and creative productivity are influenced by a number of specific context or climate dimensions, including such factors as freedom, challenge, idea support, dynamism, debate, conflict and idea time (see: Isaksen, Dorval, & Treffinger, 1994, for example).

- **Outcomes.** Our goals, aspirations and expectations, and those of others who are involved in any tasks upon which we work, also play a role in influencing inventiveness and creativity. We create and work—upward, downward, or horizontally ("marching in place")—in relation to the goals and visions we establish and accept. We also define and apply, for our work and others', the criteria by which we will assess the merit and impact of our efforts (e.g., Besemer & Treffinger, 1981; Besemer & O'Quin, 1987; Treffinger, 1988).

In sum, then, creativity is not just the result of a rare and esoteric genius, expressed through a mysterious and unpredictable muse, even though in process or in retrospect it may sometimes seem that way. It is just as much the result of deliberate, sustained efforts by individuals or groups to recognize and use their own styles, strengths and skills to attain a meaningful and important outcome, at a time, in a context and for a purpose.

Indicators and Implications for Strategies

If we begin to look seriously at the goal of exploring the creativity and inventiveness in everyone, what are some of the characteristics that might be indicators of the nature and direction of one's creative and inventive potentials, and what are some of the implications for teaching, mentoring or personal learning?

One recent effort to synthesize research on the nature and characteristics associated with creativity, in relation specifically to inventing and inventors, yielded five broad, descriptive sets of characteristics, which were termed "Inventor's Principles" (Treffinger, 1992). The five principles, with brief descriptions of several of the characteristics in each set, are presented below. Each set also includes examples of implications of those characteristics for nurturing or developing creativity and inventiveness.

1. Inventors demonstrate openness and courage.
   - being aware of, and challenging, assumptions
   - challenging accepted or "obvious" beliefs
   - being unafraid to make mistakes and willing to learn from them
   - willing to take risks
   - making "leaps" in their thinking
   - disbelieving those who say "It can't be done"
   - turning negatives into positives (setbacks into opportunities, obstacles or problems into challenges)
   - being open-minded to new possibilities
   - skeptical of "pat answers"

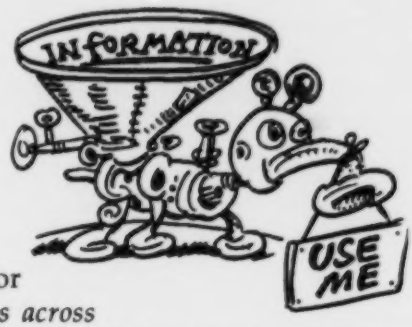
From this set of characteristics, the rationale emerges for linking creativity and inventing through activities and experiences such as *breaking limiting mental, perceptual, social, behavioral sets; questioning assumptions; challenging ideas constructively; asking "how might we..." rather than saying "we can't because..."; overcoming habit-bound thinking;* and *recognizing and overcoming internal and external blocks and barriers.*

2. Inventors observe skillfully and deeply.
   - looking beyond the obvious
   - looking at things and experiences in different and varied ways
   - using all the senses available
   - asking "why," "why not," "why else," "how" and "how else"
   - experimenting
   - finding and making patterns
   - watching for (being alert to) details that others overlook or ignore
   - perceiving gaps, paradoxes, needs or missing elements
   - noticing where ideas might lead

From this principle, the related activities and tools for creativity and inventing emphasize skills of *sharpening or improving breadth and depth of observation; digging deeper in many ways;* and *joining opposites (strange and familiar).*

3. Inventors acquire and use much information creatively.
   - going beyond the information given
   - being exposed to (and seeking out) many ideas and experiences
   - seeking breadth and variety of activities and experience
   - experimenting and testing ideas, hypotheses
   - asking many, varied and unusual questions

- taking old answers as starting points for posing new questions
- gathering knowledge/data from many sources and domains
- making connections that transcend ordinary "boundaries" of disciplines, fields or modes of inquiry



From this principle, the related activities and tools for creativity and inventing emphasize *making connections across content domains; learning many ways to gather, organize, analyze, display or present and interpret data; searching widely for information and ideas* and *asking probing questions.*

4. Inventors know how to generate and analyze possibilities.
   - asking "what if" or "just suppose"
   - thinking of many, varied and unusual possibilities
   - turning ideas around playfully
   - predicting, speculating, forecasting
   - combining or changing parts to make new possibilities
   - using metaphors or analogies
   - trying different possibilities to get "unstuck"
   - looking at one thing and seeing something else
   - making inferences and deductions
   - sequencing, categorizing and judging the relevance of data
   - analyzing possibilities in balanced and constructive ways
   - defining problems and sub-problems constructively
   - deciding, evaluating, choosing promising options
   - translating ideas into actions

From this principle, the related creativity activities and tools for inventing emphasize *learning, practicing and using (authentically) many idea-generating techniques (divergent/creative thinking) and idea-analyzing (convergent/critical thinking) techniques; learning and using structured approaches for problem-solving and decision-making.*

5. Inventors know and listen to their "inner voice."
   - trusting their own judgment
   - having confidence and persistence in pursuing their own ideas and goals
   - trusting their own hunches or intuitions
   - becoming absorbed in their passions—losing sight of time and place
   - not giving up in the face of disdain, discouragement or ridicule from others
   - refusing to be beaten down by dismay when things aren't working

- being skeptical of others' ideas— and their own
- Investing great effort, energy, time and personal resources in their ideas and work
- holding their commitments strongly
- seeing their efforts through to conclusions, products or outcomes

From this principle, the related creativity activities and tools for inventing emphasize *awareness of challenges and opportunities; recognizing talents, strengths and sustained interests; providing time, encouragement, resources and support to pursue talents and interests; perceiving gaps and needs; building self-confidence, trust* and *perseverance.*

Personal and Educational Implications

Let us consider some of the implications of these principles and the strategies or methods associated with them, for individuals who wish to discover and develop their own creativity inventiveness and for teachers or others who seek to develop the skills and talents of inventive thinking among others.

First, think of these principles as *invitations.* Your own personal creativity and inventiveness can be at work when, in your own areas of talent and interest, and through your own preferred style of working, learning, producing and sharing, you draw upon any of these characteristics and use them in dealing with new tasks, opportunities or challenges.

At the personal or self-directing level, the most obvious implication (which may nonetheless be worth stating) seems, then, to be: *seek out, and make deliberate or systematic efforts to discover and use the creativity and inventiveness within yourself.*

The investment you make in knowing yourself—your style, your interests, your "driving force"—will help you to be that person as well or as authentically as you are able. Focus your efforts on knowing who you are, capitalizing on your strengths, talents, sustained interests and best ways of learning and working. You need have little or no concern about trying to be creative in ways that fit some stereotyped expectations about "the creative person." Find and immerse yourself in what's best and right for you. Dr. E. P. Torrance has spoken for years about finding and focusing on your "passion," and his emphasis is well-founded. What about being "well rounded"? It's fine— if your goal is to grow up to be a golf ball.

Use PLTS #6-11 as self-assessment tools.

For educators or others who seek to nurture creativity and inventiveness among their students or colleagues, there are several important implications. These include:

- Give more time and much more deliberate effort to seeking all students' best strengths and talents, and respond to them in appropriate and varied ways.

- Worry less about trying to get everyone sorted and gathered into the correct "bins." Don't assume that a level playing field means that you have to teach everyone as if there were no differences among people. Respond to who people are, and what they need, not to categories.

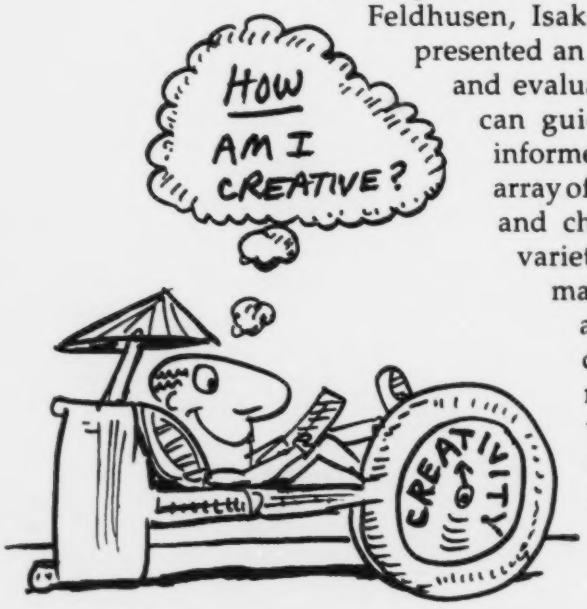
- Take time to monitor your instructional efforts and to evaluate their impact and effectiveness; reflect on and debrief your activities and programs, as a foundation for continuous improvement.

The educational or instructional implications of new views of operations or strategies focuses on the question, "What works best for whom, and under what circumstances?" This view challenges us to explore such issues as:

- How do we use our knowledge of students' characteristics to design and deliver instruction more effectively?

- What kinds of productive thinking operations or methods are most successfully learned and applied, and in what ways, by different learners, at different times and for different purposes?

A final recommendation for educators or trainers is to become critical consumers of information and resources on creative and inventive thinking, making deliberate efforts to compare and evaluate various approaches. Treffinger, Feldhusen, Isaksen, Cross, Remle and Sortore (1993) presented an extensive set of 15 criteria for reviewing and evaluating published materials. These criteria can guide educators in their efforts to make informed decisions. The field includes a diverse array of offerings, from the enthusiastic, engaging and charismatic entrepreneurial creators of a variety of unresearched, untested packages, to many other approaches that are based on, and supported by, many years of theory development, research and practice. Many new research efforts are also in process, which will continue to help educators expand and enhance their efforts. These include, for example, investigations of ways to link process skills more effectively to learner characteristics, specific task or outcome parameters and varied



environments or settings (e.g., Isaksen, Puccio, & Treffinger, 1993). Recent developments have also included searching for ways to help people select and apply various methods and strategies in natural and flexible ways that construct meaning personally rather than presuming it can be imposed externally upon the problem solver (e.g., Isaksen, Dorval, & Treffinger, 1994; Treffinger, Isaksen, & Dorval, 1994). Critical consumers need to be aware of the variety of, and differences among, many models and approaches, and to study the alternatives carefully in order to make effective decisions.

Summary

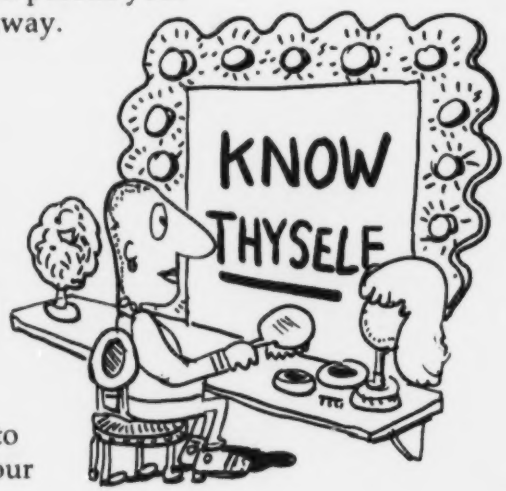
1. Everyone has the potential or capability for creativity and inventiveness.

2. Know your style and strengths, and commit yourself to them with vigor and singleness of purpose. Discover and pursue your passion, and don't let anyone beat you away.

3. Consider the context in which you will be operating. If it isn't conducive to creative efforts, change it—or change where you are (get away from it).

4. Make a deliberate effort to learn, and to be able to select and choose for yourself, many different strategies or operations for productive thinking.

5. If you're an educator, work always to create and sustain opportunities for all your students to do all these things, too.



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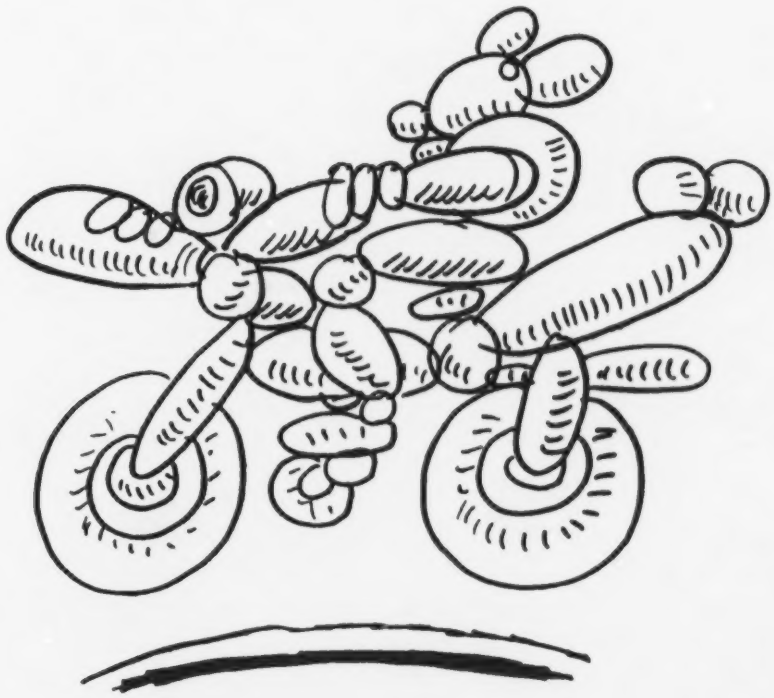
BALLOON ARTISTRY

(A Fun Way To Be Creative)

DR. LEONARD MOLOTSKY

Dr. Leonard Molotsky

Dr. Molotsky is Executive Director of the National Inventive Thinking Association, and a noted former teacher and administrator in education. He was the 1991 recipient of the Donald J. Quigg Award for creativity and excellence in education. He has been nationally involved in activities to motivate both teachers and students towards the goal of creative and inventive thinking in our schools. He has been a noted presenter at conferences throughout the United States on numerous topics including activities for developing creative skills. Based upon the fact that most children of all ages are enticed by balloon artistic structures, he has focused this chapter upon how this type of activity can be used with students. This is a unique section not normally found in educational books, but follows the theme of this book–creativity and thinking.



BALLOON ARTISTRY

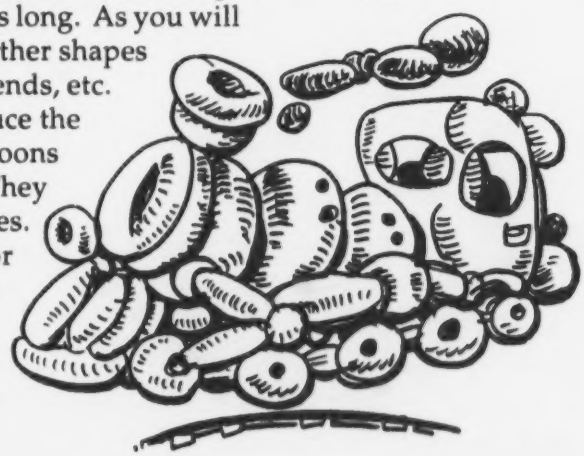
(A Fun Way To Be Creative)

DR. LEONARD MOLOTSKY

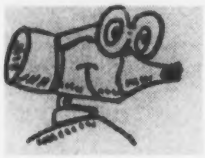
Every child, no matter what the age (including adults) has always marveled at the work of the circus clown, or the clown at the big festival that makes balloon sculptures through his artistry. This is a great motivational tool. Recently I observed a professional clown dressed in regular street clothes at the Dallas/Ft. Worth airport. He, along with many others, was waiting for a plane to arrive. As he was sitting there, he kept pulling balloons out of his pocket and making all sorts of figures, first for the children, then the teenagers, and then the adults. In fact, there was a big crowd around this one man who was just having a lot of fun waiting. We all know that clowns are creative people, not only with balloons, but through the shows and actions they perform entertaining anyone around; whether they be in a circus, festival, hospital, or orphanage. This chapter is dedicated to these creative individuals. Hopefully, the techniques and information I have provided will excite you into utilizing hands-on creativity with children of all ages.

I define balloon artistry as utilizing balloons of any size, shape, form or length, to be used singly or in groups of two or more, to form some resemblance of an object, animal, or plant. How one gets these balloons shaped like this can involve various steps and creative ideas. By teaching the students some basic steps in utilizing balloons and in formulating the figures, they are able to develop their own figures, animals, plants, hats, swords, etc. The variations they exhibit will give different results, details and descriptions. Not only will you be able to utilize these skills, but the question of materials and equipment will be explained fully to allow ease of implementation, with every student being able to make their own replica or invention.

First, let us consider the characteristics of the balloons you will be using. The quality will be the same as that used by circus clowns. The number which identifies the balloon is 260. This actually means that when the balloon is blown up to its fullest, it is two inches in diameter and sixty inches long. As you will learn later, balloons can be made to take other shapes and diameters depending on pressures, bends, etc. To reduce the age of the balloon, and reduce the "pop" factor, you should know that balloons are affected by light, heat, and age. They should always be stored in cool, dark places. When stored like this they will last for months. Better yet, if you're keeping the supply for a long, long time you might want to put them in a baggie and actually freeze them. If balloons are frozen you should allow them to thaw out slowly



over a 24 hour period. Note that students should be cautioned not to allow balloons to be close to their eyes in case one does pop. Balloons can be made weak at strategic points by pulling, snapping and twisting the balloon. Sometimes this is desirable to get special effects as you will see.



Use PLTS 's 1,5,6,10,and 11 throughout the activities in this section as tools for teaching inventors' principles and self-assessment.

When blowing up a balloon, one should first stretch the balloon before it is actually inflated. Some students will have difficulty tying the knot on the end of the balloon so some time should be allowed to teach correct inflation and tying of the knot. You will note that if you are going to do a lot of knot tying, you might want to teach the students how to hold their fingers as in **Figure 1**, so that the balloon can be held under the arm and the knot or inflation end can sweep under your two fingers around and through the knot.

Figure 1

If the length of the balloon stem is not long enough one may make a little bubble on that end as in **Figures 2 and 3**, and allow the air to escape thus resulting in a longer piece of the balloon to tie that knot. There is no need to pull hard on the knot because this just weakens the balloon at that point.

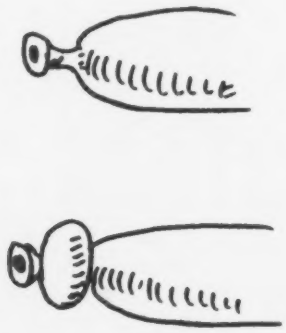


Figure 2

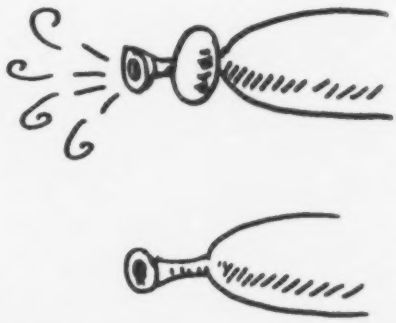


Figure 3

Many of your creations will require twisting the balloon and making bubbles of different sizes or lengths and will require final twists of some bubbles. It is important to remember that when twisting a balloon to make a bubble or a small length always twist

in the same direction and hold the first bubble or length that you're working with and the last bubble or the body in many cases. Also, don't change hands in making sculptures. When doing this, sometimes you have a tendency to turn the opposite direction, thus losing your bubble.

In regard to inflating the balloons, there are aids for the instructor. You do not have to inflate them with your mouth. There are numerous types and sizes of balloon pumps. Everything from a hand pump to a pogostick type pump to the powerful floor mounted pump. At the end of this chapter, I will give you more details on buying pumps. When working with a class of students, it's going to be necessary to preinflate balloons or have a pump that may be utilized to rapidly blow up balloons for students who may be utilizing more than one balloon in making a more difficult and intricate structure. I like the pogotype balloon pump because I can take it with me just about anywhere, whereas the floor type is usually much too large for travel. In inflating balloons, it should be noted that in most situations a noninflated length should be left at the end of the balloon for expansion as various parts are twisted. The length of this will depend upon the type of animal, plant, or structure that is being completed. Many times this tail or small section is necessary for the type of animal or object that is being created.

I suggest that now we get started! Remember, you are teaching the students some techniques and skills and they then can imagine and develop their own methods of arriving at the desired product. In fact, refining and improving on the product is what we're looking for, as well as new products and ideas to be created with one or more balloons. It should be noted too, that though we are using primarily the long balloons, you can incorporate round balloons, heart shaped balloons and various other balloons. Students are limited only by their imagination and ingenuity.

Let's take a very popular item and a very easy one to make. Consider the school colors or the basic red, white and blue of the United States and fill three such balloons leaving a little bit of uninflated balloon at the end as a tail for each of the three balloons. As in **Figure 4,** grab the three balloons which should be approximately the same in length, using the stem end of each. Placing them together and making a double twist which connects all three of the balloons. Note the figure for the appropriate twist.

Figure 4

Now have a student hold the tied ends while you actually braid the balloons one over the other, red, white and blue or the school colors. When you come to the end take the end pieces and again hold them together and twist all together making a double connection. We now have a twist which will stay that way until you either break the balloon or it becomes untied in some way. Students really love these twists because they

can make them with all different colors. You may want to start with two balloons, advance to three balloons, and then ask are there other ways to make twists or other numbers of balloons that you would like to utilize.

The next activity will produce an animal figure. This is a basic sculpture that depending upon the proportions used, could be a dog, a giraffe, a dachshund, a squirrel, a mouse, a rabbit or a monkey. The first one we will make has less detail and is easy to utilize. Look at **Figure 5** for making the dog.

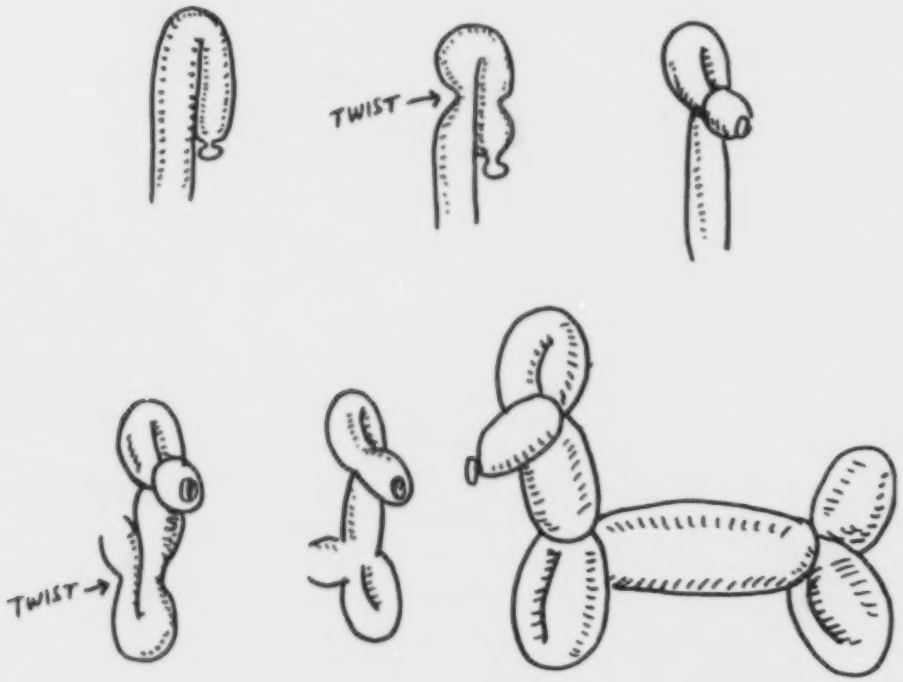


Figure 5

Note the curve in the diagram and the twist to make the face and the ears. The neck portion may be varied to be either long or short, fairly short for the dog. The ears that you make can be varied as to lengths making whatever figure you want, but in this case more like a dog. Then the front legs, the hind legs and finally the tail all dealing with the curvature of the balloon as indicated in the drawing and the twists as shown. You can see that if you wanted a giraffe, you would make very small ears, a long neck and a very short tail and long legs. If you wanted a rabbit, you would make very long ears and the legs can also be varied in length. Are there other animals which you can think of making on this same basic structure but different proportions?

Let's now look at another way to make the dog utilizing bubbles, instead of the twists that I have shown you. Take the balloon leaving again the tail portion to the last. You use the stem end first, making a small bubble for the head, another bubble for one ear and a second bubble for the second ear. Hold that and then loop the ears together and make a twist as shown in the diagram. Note that the ears are probably more desirable than those in the faster version you first had illustrated. We now can go on making bubbles just as we have for the rest of the body. Note the diagram. **Figure 6.**

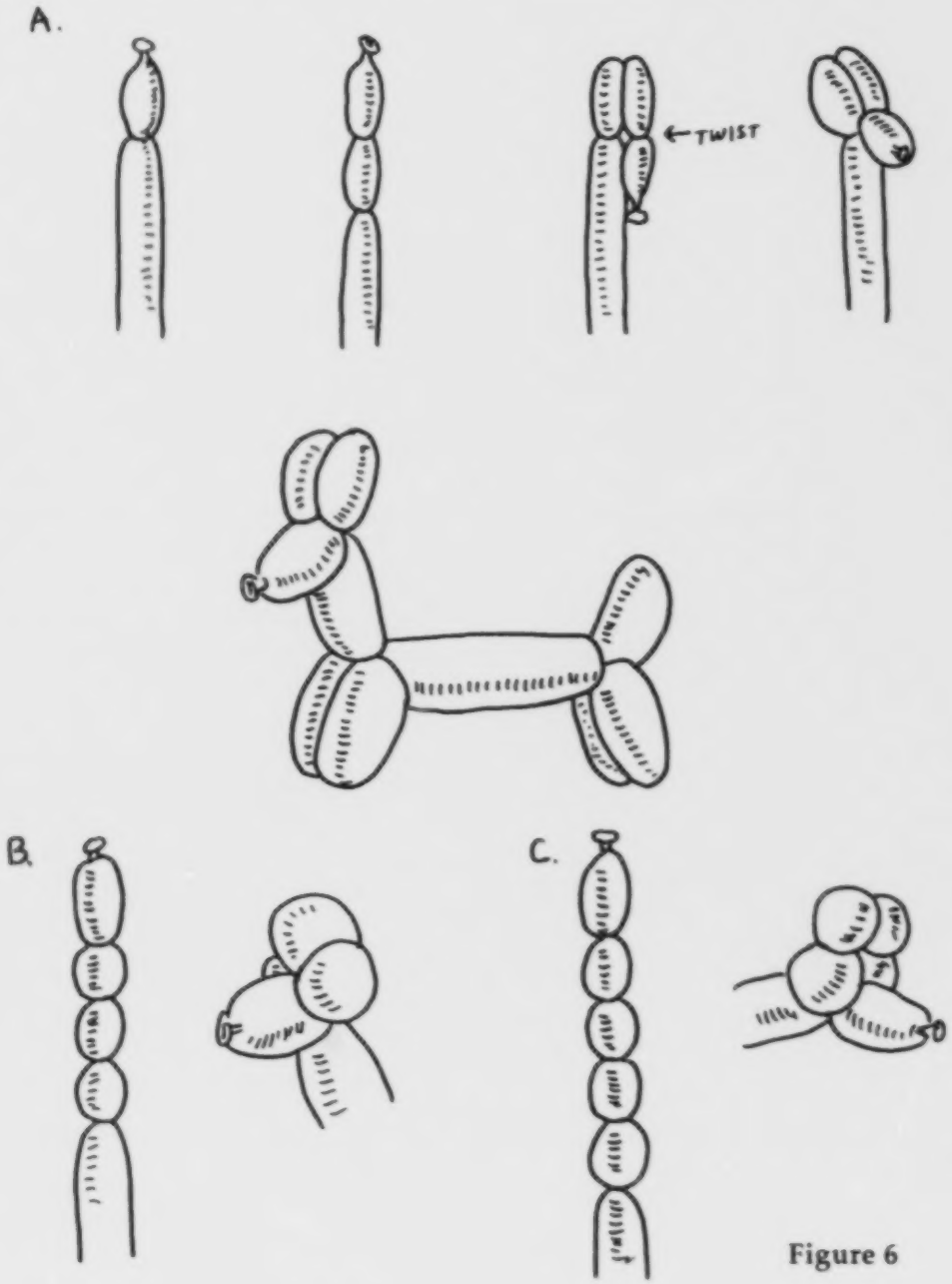


Figure 6

Let's now examine the poodle head or poodle dog. **Figure 7** illustrates the easy way to do the head and how one might slip the balloon head back through the ears to make it look like a poodle and how secondly, one might utilize the bubbles to make the poodle head more unique. I think these show good illustrations on various ways to achieve your goal of balloon artistry. Now it is up to you to think of your best way or a more detailed way if you wish. My intent now is to give other illustrative items without the advice of other ways to develop them. Use your own imagination and that of your students.

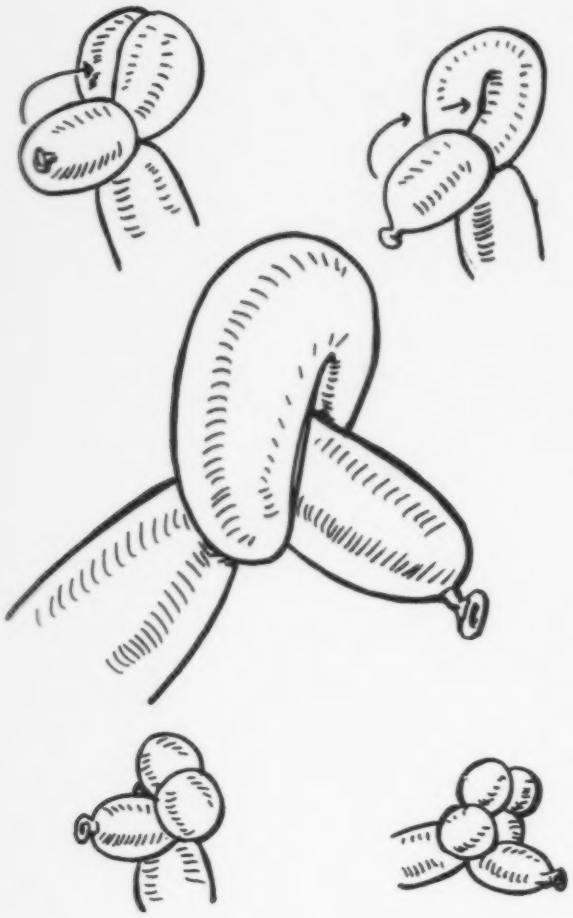


Figure 7

Our next object is a hat. Hats vary in construction, the number of balloons involved, the way balloons are linked, etc. The easiest, of course, is the first illustration, **Figure 8.**

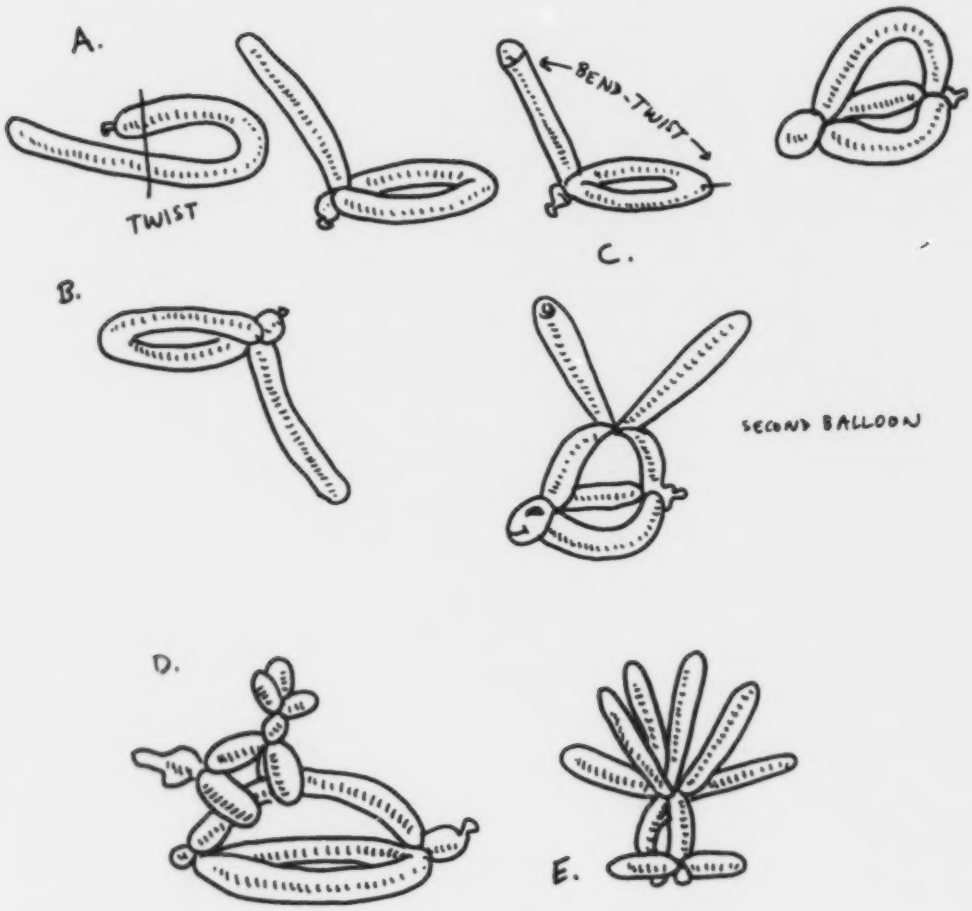


Figure 8

Place the balloon around the child's head or the person's head and make a twist leaving a long end and the circle that fits over the head. This might be a Daniel Boone type hat or it might be an elephant as shown. Or we can take the long section and loop it over to the other side of the balloon and make a loop twist and you now have an arc. One variation would be to add another balloon which would be tied again to the balloon to make the arc a little higher and you can continue making other adjustments. If you look at **Figure 8**, you'll note that hats can incorporate other balloons, notice the second balloon being put in the middle of the loop and twisted. You might want to even adjust this to make two, three or four balloons. You can make the hat look like a helicopter. Taking the single loop in **Figure 8**, you'll note that an animal or some structure can be

placed in the loop at the top part of the hat. By using the force of your hand and heat from your other hand you can force push the balloon so that it actually tapers to the front or to the back of the loop on the hat. You can use balloons to make ear like structures (rabbit ears, as in **Figure 9**.)

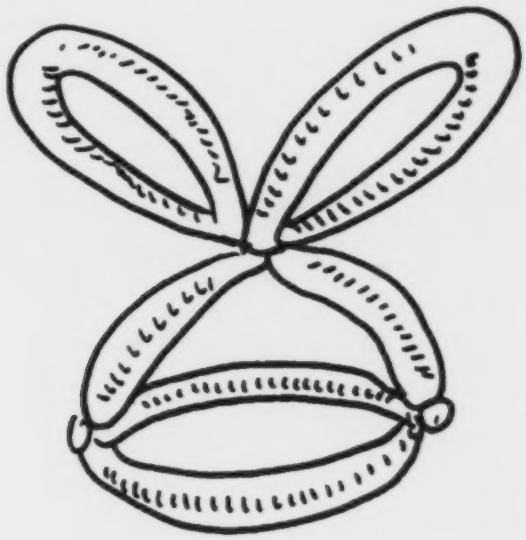


Figure 9

A very popular item for boys is the sword. Notice the sword can be made very rapidly by using the S curve as shown in the **Figure 10** and a twist. You now have a handle and two loops as part of the sword's handle. You can rub on the balloon blade section and straighten it out. A variation of the sword is the saber, another popular item. The saber can be made by making the loop as in **Figure 11** and note that the blade is pushed through the loop to make your handle. Straighten out the blade of the balloon with your hand or warming it up by rubbing it. Students might want some kind of a holster for the saber or the sword, so taking another balloon, you can put it around the student with a loop and taking the two ends of the balloon, tie them together with a small bubble. On the opposite side, make a loop large enough for the blade of the saber or sword to fit inside and it will be like a regular holster. Now are there other ways that these structures can be made or are there other structures that you'd like to make from these?

Figure10

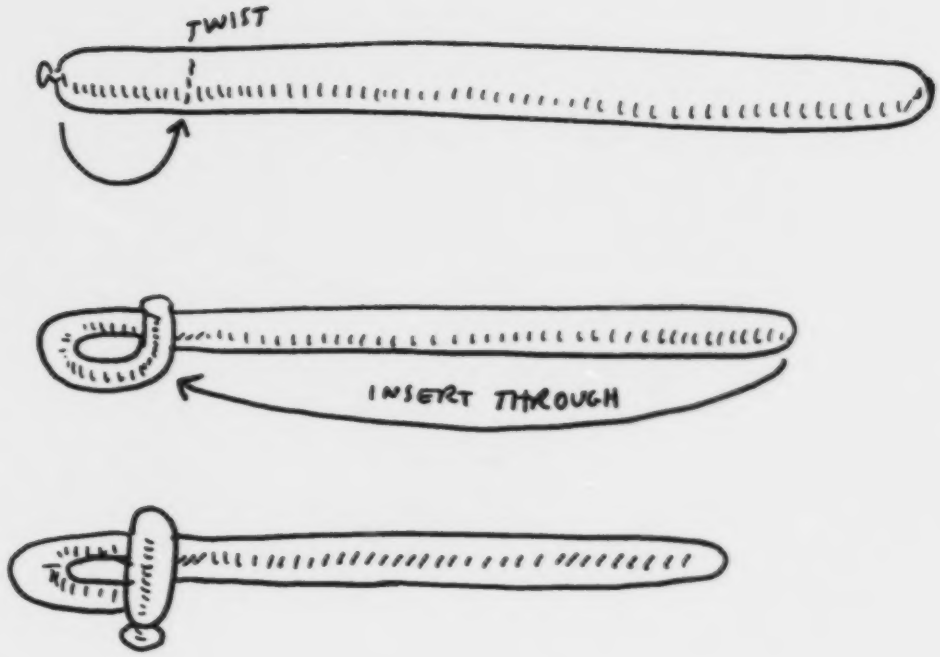


Figure 11

The flowers are fun because you can use any variety or number of balloons as shown in **Figure 12A** and **Figure12B.**

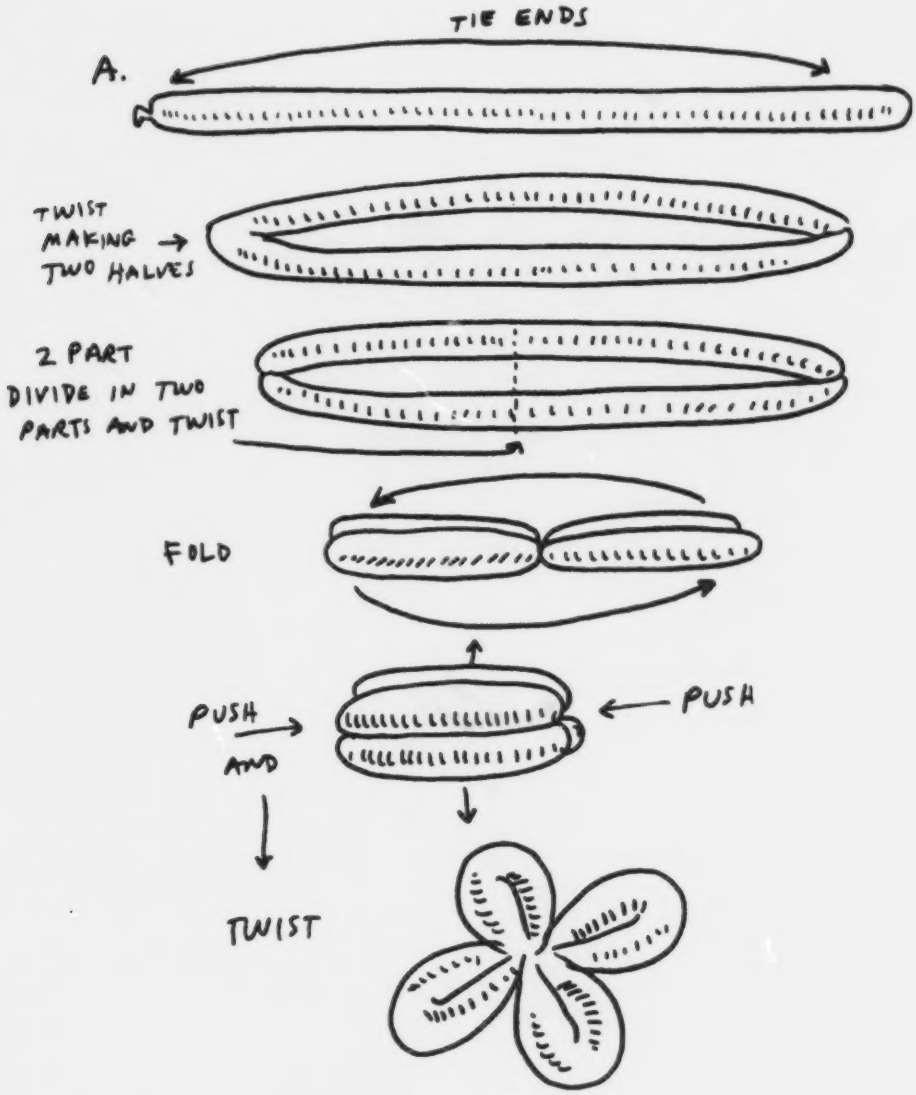


Figure 12A

Take a balloon of any color (I like to use red for a bright flower) and tie the nozzle and the tail end of the balloon together as shown. Find the midpoint of the balloon and twist one side so that there are definitely two pieces to the balloon now. Find the middle of the two balloons sections and twist again, making two halves of the balloon, then fold the halves over as shown. Usings your two hands, pushing in on the ends and twisting, you now have a four petal flower.

To make a six petal flower you can do the same thing.

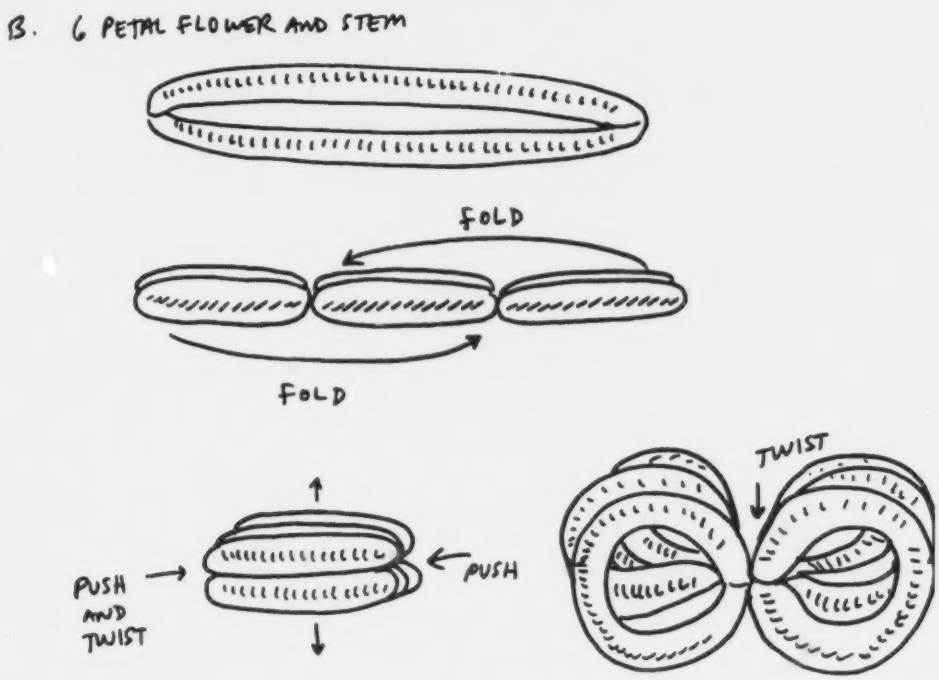


Figure 12B

When blowing up the balloon you'll find that you can make it a little longer than the 60 inches, but a little narrower, as you push down on the pump you stretch the balloon slowly (as you stretch you can make it longer.) Make yourself a real long balloon leaving a little bit at the end, tie the ends and find the center point as you did previously, roll one side so that you now have 2 halves of the one balloon. Now, instead of making two equal parts, make three equal sections at each section, make a twist to be sure that it's separated. Fold them over, this is more difficult for small students to handle because it takes more pressure to push in on the end, and make a twist. (This makes a six petal flower.) Are there ways to use more balloons to make more petal flowers? We have just the head of the flower. Use a green colored balloon and fill it up leaving about two inches of tail. Take the tip of the tail and pull on it a little bit and pop up a bubble in the end of the tail. You have something looking as in **Figure 13.**

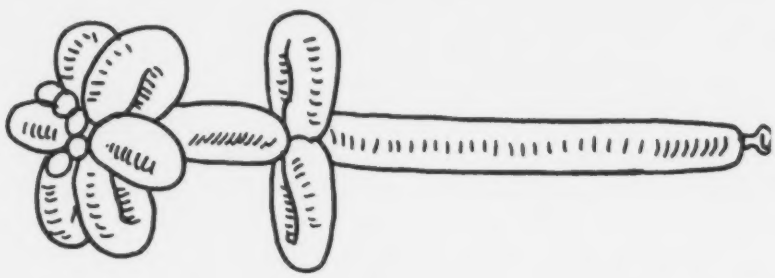


Figure 13

Now holding the bulb in one hand and the rest of the plant in the other hand, work the small tail into the flower with the bubble sticking on top. To make this flower more realistic, I suggest that we put some leaves on our stem by making the fold as shown and twisting. Whether its a four petal or a six petal flower, how might you make different centers for your flower? One suggestion might be to take a green balloon and make a series of two bubbles, three bubbles or four bubbles, twisting them and then work the stem through the flower as before. Another variation on making a flower is to use four heart shaped balloons, tie them together in the middle by their stems, and then work the green tail in between them as you did the other flower. This makes a beautiful four petal flower all heart shaped. It's a good item for Valentine's Day. Now what other shaped balloons can be used to make flowers and how could we make different types of stems and different types of flower centers?

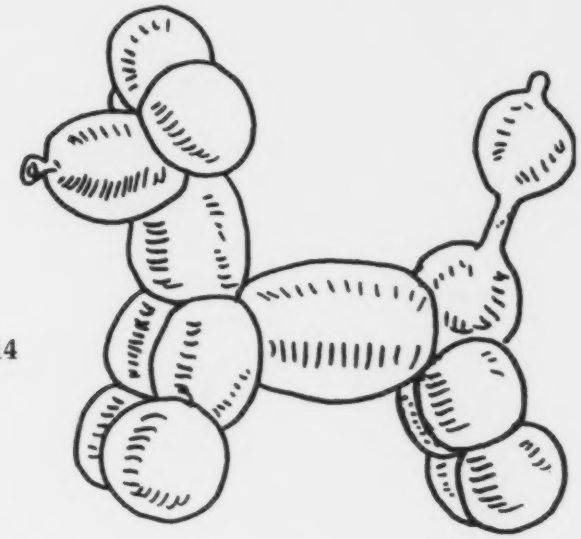


Figure 14

You will find too that other animals can be made from different shaped balloons. A special shaped balloon for bees can be obtained as well as round balloons and other variations to make animals and plants. Balloon artistry is fun, making parpulling, snapping, resulting in more realistic structures. Faces of animals which can be made by pulling the stem out and snapping making an elongated portion. Or thinner parts of the balloon can be utilized by making a circle out of your finger and not allowing the balloon to expand to two inches. The more you work with your hands and the balloon you will find that there are things to do that will alter the normal shape of the balloon and give you the configuration that you want. A good example is making the poodle head. If the tail of the poodle is about two inches or three inches long uninflated, then the tail can be snapped and made weak and a bubble will be popped into the tail making the poodle look like its been groomed **Figure 14**. More creativity in making these animals involves the use of marking pens to fill in the eyes, mouth, ears or other structures for more detail.

Before going on to discuss the source of supplies and pumps, I would like to illustrate my favorite, the bear. This one is a favorite of most children also. Look at the illustration in **Figure 15.**

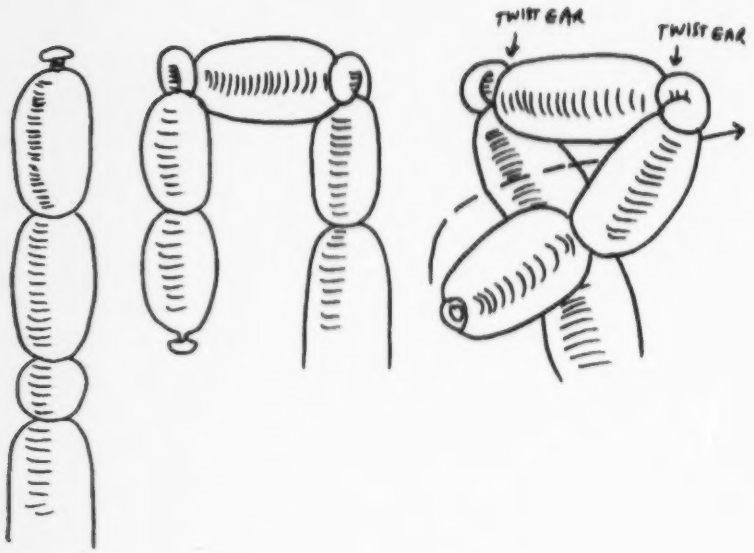


Figure 15

Start after the inflation of the balloon allowing approximately a two inch tail. On the stem side make a short bubble approximately one and one half inches in diameter. Make a second bubble one and one half inches. Make a third bubble or length which is approximately two and one half or three inches and then a very small bubble, which will be one ear, one inch or less. Now make another three inch bubble the forehead, another small ear which is the same size as the first one, and then a bubble which will match the jaw or section on the other side, and of course you have remaining the rest of the balloon. Twist the jaws together allowing the first two bubbles to come back through the back of the head causing the first one to protrude as the nose, and the second one allowing the extension as shown in **Figure 16.**

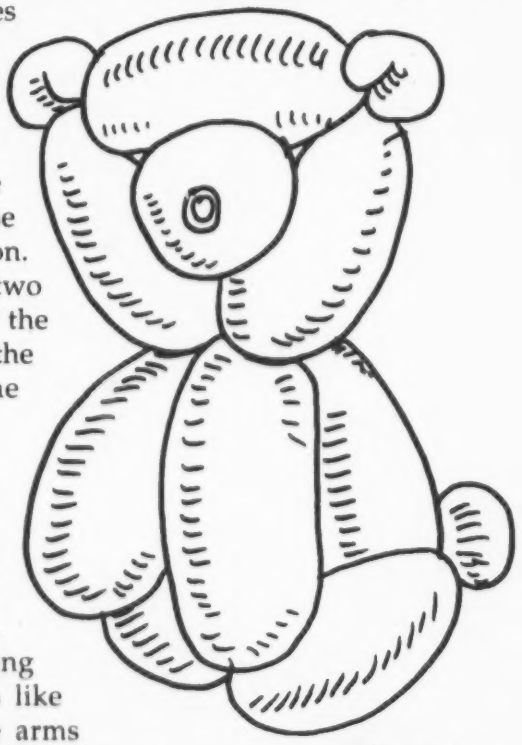


Figure 16

To tighten the nose hold the ear while holding the sections together and twist, actually taking the shape of an ear. Mold the second ear and twist it - this tightens everything together. Now we have the head, it looks like a bear, and anytime you're making an animal, plant, or whatever, if it looks like whatever it's supposed to be, it is that! The arms can be made by the familiar loops of construction of

animals, followed by the short body, the hind feet and the short tail. You have made a bear as illustrated, and the bear is a very good creation for a hat, its a very good one for climbing a pole, or make a walking loop out of another balloon and use it as a collar and strap to walk your bear. I could suggest other types of figures and animals and combinations, such as the balloons that we recognize for riding in the sky with their cradles or baskets, as well as ships or airplanes, they all can be made. Just envision the object, how it can be made, and make it.

It took me several years of research to find a source of materials. I was very fortunate to locate where the Ringling Brothers Barnum & Bailey Circus clowns, and many others, buy their balloons. I'm going to give you this source to get you going right away. The operators of this company are Tom and Maryanne Myers and they are known as T. Myers Magic. They do mail order sales and periodically have a free catalogue. You should send them $6.00 to get on their newsletter mailing list. They are wonderful people to get you going and help when you have a problem. In their catalogue, which gives all the new types of materials and equipment, they illustrate new balloon sculptures and figures. They will also give you information on workshops. They not only sell materials, but also put on workshops throughout the United States. They guarantee all balloons and also have available a variety of pumps. Of course, I am sure there are other sources of such materials, but Tom is very unique in looking for quality. Balloons may be purchased by the gross—remember how to keep them fresh and in good shape. Write or call T. Myers Magic, 1509 Parker Bend, Austin, Texas, 78734, 512-263-2313. (For ordering, 1-800-648-6221.) By the way, they have hundreds of books and two excellent video tapes that will help you in seeing the twisting of the balloons and the care necessary in making the artistic figures. Be creative—Begin Now!

Hints to the Teacher: Linking Creativity and Inventive Thinking to Ballooning

It is important to link student activities to strategies for developing creative and inventive thinking skills. As you implement the ballooning program be sure to relate to the following:

1. Observing.....Look at an object/animal you would like to make in balloon form and determine its most **prominent** characteristics. Use **observing** to decide characteristics. Use observing to decide what are those most important parts to use to make our specific sculpture distinctive and recognizable.

2. Generating Possibilities.....Think of several different kinds of the same objects or animals; i. e. How many different dogs can be generated? Ask yourself, "What's unique or different about each one? How will your balloon sculpture look different in each case? " Generate a sculpture and ask what are all the things it might represent. List many different, varied, or unusual views/positions in which your balloon sculpture can be depicted as with a dog, it might be standing, sitting, running, eating, playing, jumping, pointing, etc.

3. Identifying Variations.....Determine through questioning what **elements** of a balloon figure one can deliberately modify or vary. Some areas might include: overall size of figure, number of balloons used, length of each balloon, diameter, amount of inflation, shape of balloon, color, etc. Ask if there are others.

4. Morphological Strategy.....In an effort to force ideas and changes consider the use of the following example. Select one item from each column and create the sculpture identified. As an example, one might choose: life-sized, red, standing, dog and (1) balloon. Thus the student is challenged to create a red colored standing dog with one balloon of life-sized creation.

Shape/Size	Color	Position	Creation	Number of Balloons
miniature	blue	standing	dog	1
life-size	red	sitting	cat	2
huge	yellow	running	rabbit	3
giant	green	sleeping	frog	4
mutant	purple	flying	dinosaur	5
stretched	pink	jumping	horse	6
shriveled	white	dancing	elephant	7
round	orange	holding	snake	8
square	black	supporting	fish	9

Stretch yourself and your students with Balloon Artistry - Enjoy!

Encouraging Thinking Skills Through Conversations With Children

Marge Korzelius
and
Marion Cañedo

Marion Cañedo

Marion Cañedo is President of the National Inventive Thinking Association. She is a former New York Teacher of the Year and author of many publications on creative and inventive thinking, including the Project XL Inventive Thinking Curriculum published by the United States Patent Office. Marion is currently the Director of Early Childhood Centers and Academy Programs and Co-Chairperson of the Western New York Invention Convention. Based on her observation that children and adults must communicate to develop an expanded understanding of language and thinking, she and Marge Korzelius have collaborated on this chapter.

Marge Korzelius

Marge Korzelius is a trainer for the development of critical and creative thinking skills. She is on the Board of Directors for the National Inventive Thinking Association and is also Vice President of the New York State Prekindergarten Administrator's Association. Marge has been a consultant for various school systems and has presented at many conferences throughout the country. Marge is currently the Director of Prekindergarten Education for the Buffalo Public Schools and Co-Chairperson for the Western New York Invention Convention. Based on her observation that children who have highly developed thinking skills also seem to have a rich vocabulary, she and Marion Cañedo have collaborated on this chapter.

68A

Encouraging Thinking Skills Through Conversations With Children

Marge Korzelius and Marion Cañedo

When employers are asked to identify the single most important characteristic of an employee, the response is often the ability to think and solve problems. Historically, our children learned and practiced those abilities at home. Their thought processes were clarified by hands-on activities around the farm or house which were often verbalized and refined at the dinner table. Times change. Now, these avenues of practice don't exist for many children. The personal interaction necessary to nurture effective thinking processes in family settings is held hostage to the hectic pace of modern life and the advent of television. Educators have an exciting opportunity to promote adult-child interaction on a continuing basis in our schools and to begin to encourage it at home. Conversations with children must begin at the very earliest age in order to promote thinking and two-way communication.

Textbooks often include activities that may be classified as thinking skills. However, application of these skills is rarely taught outside the confines of a formal lesson. The common notion is that, at some point, the child can use skills he has been exposed to in formal lessons and synthesize and apply these processes in new situations. In fact, sometimes this happens, and sometimes it doesn't; it's haphazard at best. However, if practice is given in the application of these skills through the elementary grades the child gains proficiency and also becomes confident of his own ability.

One way of providing practice is through carefully planned, two-way conversations. In classes, where the emphasis is on whole language, a framework

that fosters practice through conversations already exists. Effective oral communication and good thinking can go hand in hand.

In order to teach and nurture thinking skills, several conditions must be met. The adult must be:

- aware of the thinking skill,
- convinced that these skills are important and an integral part of a child's education and
- so familiar with methods of encouraging these skills that he or she automatically uses them in conversations.

Good teachers "cook up" creative lessons in which children use these skills actively. When asked about their reason for using a chosen technique, varied responses occur. Some say they try to get the child to participate actively promote understanding or build interest in the lesson. However, these become isolated activities, specific to the lesson. If the teacher recognizes a thinking skill as one that the child can internalize and apply to varied situations, then the teacher can systematically provide opportunities for the child to practice this ability.

The reason we have selected the following thinking skills is because they lend themselves readily to promoting dialog and conversation between adults and children. Adults or experts must communicate with children in order to build understanding and clarify meaning.

These thinking skills are:

I. CAUSE AND EFFECT

II. CLASSIFICATION AND RELATIONSHIPS

III. SEQUENCING AND PLANNING

IV. MAKING DECISIONS

V. ENRICHING VOCABULARY

VI. GENERATING QUESTIONS

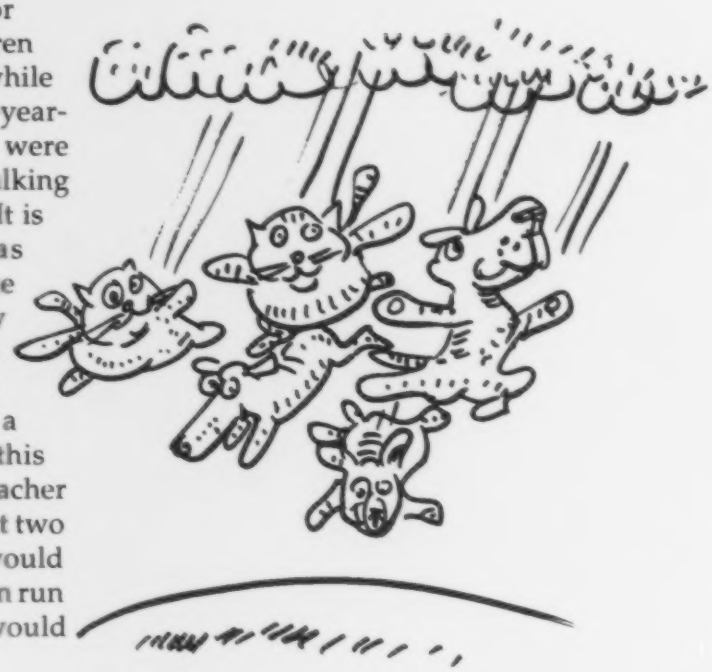
At first, children could work in teams, cooperative groups or with the whole class. Many children are shy about sharing their ideas. Initially, it may be more comfortable for some to sit back and listen.

Here are some suggestions to help the teacher get started in developing thinking skills through conversations.

I. CAUSE AND EFFECT THINKING

Cause and effect is mentioned in every reading series, but very few give techniques to help a child to do this naturally. It is easier for children to generate EFFECTS of a situation than CAUSES. For this reason we start with EFFECTS.

If we tickle the funny bone or stimulate the imagination, children become more involved. Once while sitting with a group of five four-year-olds on a rainy day, while they were playing with tinker toys and talking about the rain, the expression "It is raining cats and dogs!" was brought up by the teacher. The children were asked what they thought would happen if this were indeed true. This so tickled their fancy that they gave a half a dozen different EFFECTS of this situation. Then they asked the teacher to write them down. For the next two days, two of the four children would start laughing to themselves, then run up and share a new idea and it would be added to the list.



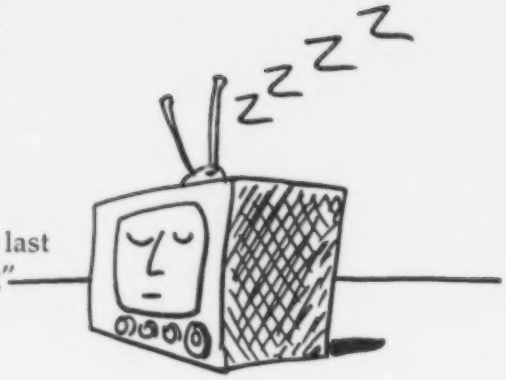
It may have been a whimsical situation, but the children generated EFFECTS that logically would follow the given situation. Other EFFECT situations can be generated from children's literature.

Use PLTS #2 with this activity in order to help identify students who look beyond the obvious.

Just to jog your creativity, the following are some examples of generating EFFECTS: The starter sentence may be: "What if .." or "Think of all the different things that could happen if.."

- everyone on earth was as tall as your thumb
- all the water in the world turned into cherry soda

- all the books on earth disappeared
- you could grow money on trees
- Germany was victorius in World War II
- all motorized vehicles disappeared
- all TV sets stopped working

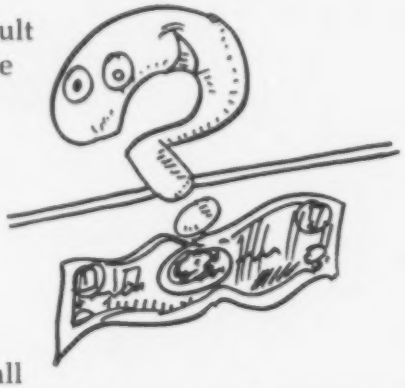


Here are some responses from children about the last EFFECT situation, "all TV sets stopped working"

- TV stations would go bankrupt
- people would get angry
- the family would do more things together
- people would talk to each other more
- more kids would get into trouble
- more people would go to the movies
- people would have to read to get information

Once children have generated and orally discussed their responses, the teacher could ask them to select a favorite one. This could then be elaborated on and perhaps acted out, drawn or written into a story poem or song.

Generating CAUSES of an event seems to be more difficult for children. Short stories sometimes help them practice this skill.



- On the way to work today, I found a dollar bill on the street. Let's think of all the different ways the dollar bill could have appeared there. Work in teams to list the possible CAUSES.

- I heard a boy laughing in the hall. Let's think of all the different things that could have caused him to laugh. In cooperative groups, generate lists of possible CAUSES for this occurance.

Identifying and discussing possible causes or effects of various situations, on a regular basis, will help to develop critical and creative thinking skills.

II. CLASSIFICATION

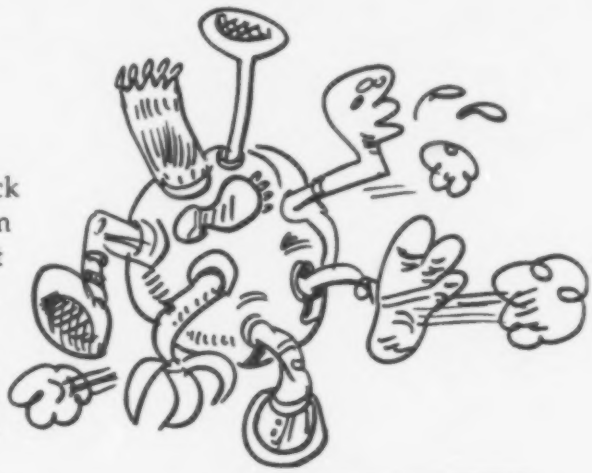
Words rarely stand alone. The brain naturally categorizes them or visualizes the object, or groups them in relationships in some way. If you ask children to think of all the things that can be hidden under the leaves in the fall, one child will mention a dog, then another will say a rabbit, a cat, a mouse, etc. What they are doing is thinking of things in a category. In this case, the category is animals. They spontaneously classify or form relationships. It is our business as teachers to foster this ability.

Think of all the things that can be:

- found in a magic box
- found in my pocket
- given as a gift
- under the bed
- taken with you on a trip to ancient Rome
- used as money

If the exercise is divergent, the children's answers can be endless. Then, these answers can be classified into categories. You also can guide the children in generating things that belong in a category. For example, let's think of all the things that:

- are in a kitchen
- run on legs
- have a motor



Each time you ask Johnny to put a toy back where it "belongs," you are helping him classify. Children learn to classify first by shape, then color, then function. Placing silhouettes on each shelf of a cabinet so that children can match the block shape that belongs there is not only a visual matching exercise, but also a thinking opportunity.

Children may construct relationships that may be considered "different." A four year old was playing with doll furniture. He was asked which things belonged together. The teacher expected the child would divide the

objects into the kitchen, living room and bathroom. Instead he put the sofa and the bed together, and the kitchen sink, toilet, stove and bathtub together. When asked to explain, he said, "You lay down on the sofa and the bed, and you use water with all of the other things." The point is there may be many unique ways children can classify objects or ideas. Our function is to help children think about relationships and clarify them.

Use PLTS #3 with this activity in order to help identify students who make connections that cross ordinary boundaries.

The following classification activity was completed with a sixth grade class. It began as a divergent exercise to answer the following question: "What are all of the things that can be taken on a trip to Ancient Rome?" Once the children generated their list of items, they began to develop categories in order to organize their thinking and classify the listed items.

Partial list of things to take to Ancient Rome:

tent	teddy bear	blankets	computer
flashlight	food	TV	walkman
clothes	money	books	sneakers
dishes	car	wagon	gun
knife	paper	pencil	matches
watch	bike	guitar	washer

Some categories developed by children:

Entertainment	Transportation	Food	Clothing
TV	bike		clothes
walkman	wagon		snakers
books	car		

The conversations and classification activities prompted the children to enhance their thinking. They discovered that they needed many more categories and additional information in order to survive on a trip to Ancient Rome.

III. SEQUENCING AND PLANNING

Sequencing is more than just identifying what happens next; it is an orderly way of thinking. If many opportunities are provided for children to plan activities sequentially, this will eventually carry over to other areas. For example, children are capable of planning how to:

- make a peanut butter sandwich
- make instant chocolate pudding
- dress for winter
- plan a trip to Ancient Rome
- change a baby's diaper
- use the paints (or any other school activity)
- make a kite
- wash a floor
- organize a party

It is easier for them to think of the sequence if they first list the things that will be needed for a project. For instance, in planning to make a peanut butter and jelly sandwich the children will mention all the things needed, then all the steps necessary to do this. However they don't usually give them in order. If these steps are written on chart paper and the teacher attempts to follow the given procedure, the children will see the necessity of organizing the sequence so it is logical. The visual impact of a teacher taking the peanut butter and spreading it on her hand is a strong indication that a step was forgotten. At this point the chart can be cut up and you can talk to the children about what happens first, what happens next, etc.

The planning skill should include:

- identifying what it is you will plan
- listing the materials needed
- listing the steps or sequencing
- thinking of the problems that can happen, so you can avoid them by adding to the materials or the steps

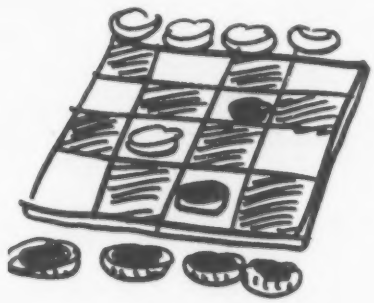
IV. MAKING DECISIONS

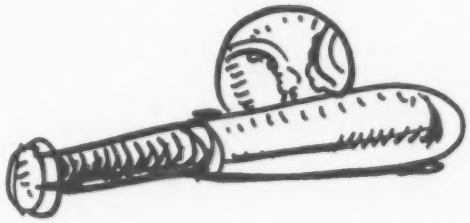
Many young children never have an opportunity to make a choice. Their clothing is picked for them and if they are in a very structured class, their activities are picked for them, etc. Making a decision is a needed skill both academically and in life. Children should be taught to weigh alternatives and give reasons for their choice. By discussing alternatives the criteria that the decision is based upon becomes clear. For example, start out with simple choices. The child must choose between:

- a cookie and a sticker
- two different games
- different colors of construction paper
- two different library books

Then the choices may be situational:

- choose a partner to play a game
- choose the best way to get across the room





For example, group decisions, through which we can teach consensus-making and other aspects of living in a society, may be encouraged.

- We're all going to discuss the different games the class can play. We will list all the alternatives and discuss them. Those who feel strongly about their choice can campaign for their choice; then we will choose one.
- We will think of all the different snacks we can have for our party. We will list the choices and discuss them and then we will choose one.

This last group of exercizes has implications in our democratic form of government and the social value of conversations and discussion that can enrich our thinking and lead to consensus.

V. ENRICHING VOCABULARY

What is thinking? How do we think?

Right now you are attending to the writing on this page. Your eyes see, and your brain must glean the meaning. In lightning speed, the brain takes these new patterns of known words and forms relationships and concepts. In order to do this, one must understand the vocabulary. If this were written in Latin, one probably would not attach meaning to the words. Words clarify our thinking. Even if right now the reader is saying, "This writer is all wet!" words were used to clarify that thought. So the very first thing we can do for a child is to enrich the child's vocabulary so that meaning can be discerned and concepts can be internalized. This can be done through adult-child dialog and conversations that will help us and the child understand how he or she thinks.

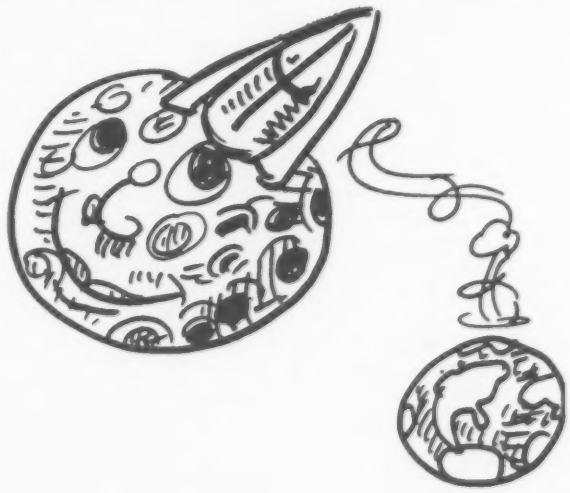
Most of our children have a greater receptive than expressive vocabulary. In order to help them build a more expressive vocabulary, we can use several techniques.

1. Generating nouns

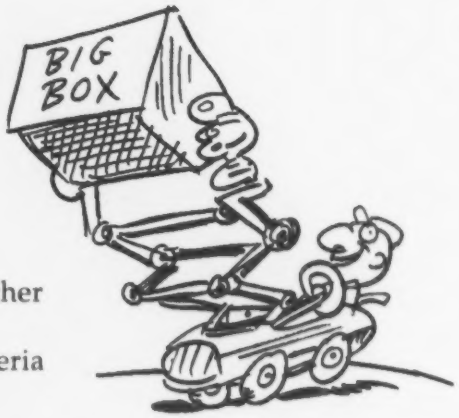
This is the easiest of the language areas for children to generate. It deals with concrete, tangible materials. Because nouns can be categorized, mentioning a member of a category brings a flood of others, i.e., if we ask about," things that have wheels," one child may mention a truck and simultaneously the other children will think of a bus, a car, a jeep, etc.

For example, think of all the things that:

- are needed to go to the moon
- pioneers need to pack in their covered wagon
- can come out of this magic box
- Jack Horner can find in his pie



2. Generating verbs and verb phrases



Think of all the different ways you could:

- get from school to home
- get a package on a top shelf
- move water from one place to another
- get from the classroom to the cafeteria

Think of all the different ways you can use:

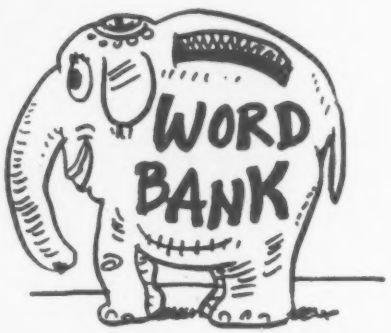
- a pop can
- a cotton ball
- a paint brush
- a paper plate
- a popsicle stick

If children are shown an object that is unfamiliar to them they can also guess what that object is. Many times teachers have brought in objects from the kitchen or the workshop. The children guess what the object might be. This promotes language and also innovative thinking.

3. Generating adjectives

Initially it would be good to start with food. This provides a focus point for the child and also is immediately gratifying because the child can get to eat it. After he or she is familiar with this process, move on to other things. For example, think of words to describe:

- a carrot
- a piece of celery
- a peanut
- an apple
- an elephant
- a home
- snow
- a tomato



4. Generating affective adjectives

These are words that describe feelings. We may make up situations to generate these words. For example, think of how you would feel if:

- you were going down a huge roller coaster
- you were late for school
- your best friend said you were wonderful
- you had to move to a new home
- you had to wear glasses for the first time
- you got up this morning and discovered you were one foot tall

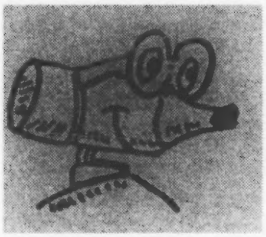
The following are some reponses from third graders, after discovering that they were only one foot tall short, puzzled, furious, happy, ugly, ridiculous, shy, weird, shrimp-like, scared, etc... Not only do the children learn descriptive adjectives to describe feelings, but they may also incorporate these words into their creative writing.

5. Generating similies

This helps children link objects with different attributes and helps build the poetry of language.

For example, think of all the things you know that are:

- as red as this candy
- as round as this bead
- as fragrant as this flower
- as fragile as this shell
- as elusive as a leprechaun
- as quiet as a lullaby



Use PLTS #6 prior to this activity in order to help students self-assess their openness and courage.

VI. GENERATING QUESTIONS

Questioning is a natural process for everyone, especially four year olds. The average four year old asks 300 questions a day. Something happens to this process on the way to sixth grade; children ask fewer and fewer questions. Since curiosity leads to learning, we want to encourage this process. For example, ask as many questions as you can about a:

- toothpick, paper clip, rubberband (or any manufactured item)
- apple, kiwi (or any food)
- Ancient Greece, Arabia, Buffalo (or any place)
- mystery item or any item you bring from home that the children are unfamiliar with

If children's questions are written down, they not only see the structure of the sentence, but the questions may be a guide to study any item. For example, children generated these questions about the rubberband:

- How far does it stretch?
- Where does it come from?
- How is it made?
- How many colors does it come in?
- How much does it cost?
- What is it made from?
- Who made it?

Using this technique, children become motivated to think and to learn through their own interest and curiosity. In general, discussing out loud and periodically writing down children's ideas or responses in any thinking area fosters the following:

- an opportunity to demonstrate that the child's thoughts are so important, that we take the time to write them down
- a sense of ownership
- incidental reading for the older child
- a knowledge of the mechanics of reading: top to bottom, left to right, spaces as delimiters of words
- the concept that words written down are ideas that someone else can read
- a written memory is possible
- a child's sense of humor and vivid imagination
- an awareness of the child's own thinking

A consistent and on-going use of these thinking skills, through activities that promote conversations with children, will enable them to internalize, name, use and apply these skills to new situations.

BRAINSTORMING

EVIE ANDREWS
AND
ANDI WILLIAMS CASE

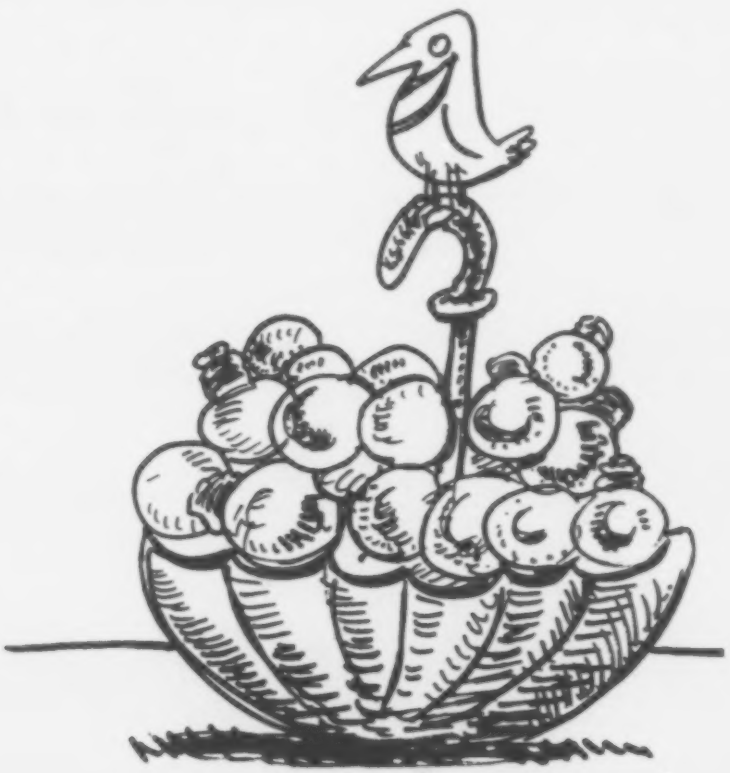
Evie Andrews

Evie Andrews is a first grade teacher at Tualatin Elementary School, Tualatin, Oregon in the Tigard/Tualatin School District. She received the 1984 Oregon Teacher of the Year Award, a Christa McAuliffe Fellowship and the Miliken Educator Award in 1991. Evie is a member of the National Inventive Thinking Association, serves as secretary of the NITA Executive Board and is on the board of the Oregon Council of Social Studies.

Andi Williams Case

Andi Case is the K-12 Administrative Director of the Gifted and Honors Programs with the Richardson Independent School District in Richardson, Texas. She currently serves as a member of the Board of Directors for the National Inventive Thinking Association and on the Executive Boards of the Texas Association of Gifted and Talented and Texas Odyssey of the Mind Association. She is co-author of the Richardson School District's Inventive Thinking materials and runs its annual "Invention Convention."

Evie and Andi have taught workshops and made presentations focusing on both creative and critical thinking, problem solving and inventive thinking throughout the United States. Their chapter is designed to help the teacher new to brainstorming get started and to provide the experienced teacher with additional activities.



BRAINSTORMING

EVIE ANDREWS AND ANDI WILLIAMS CASE

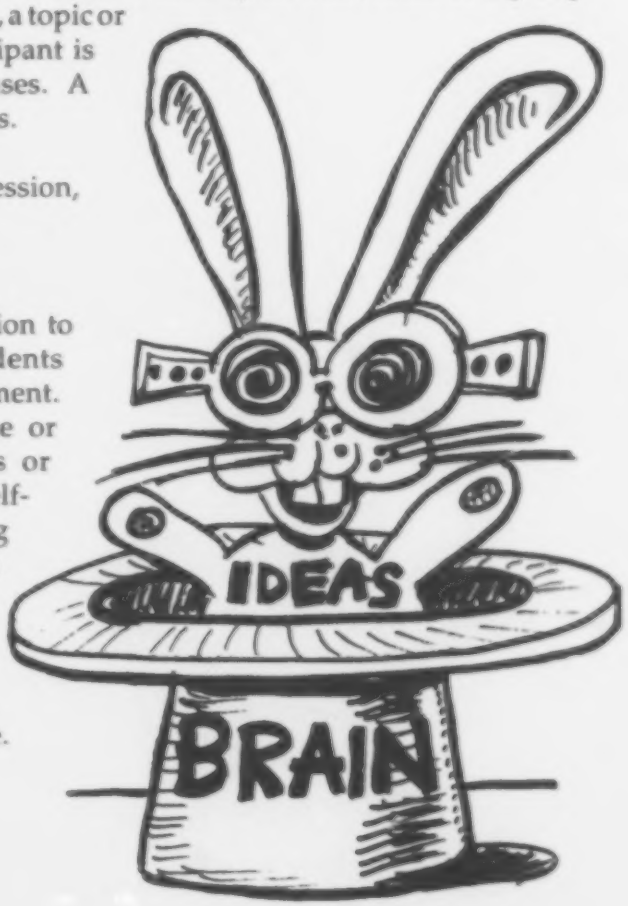
In this book, Dr. Donald Treffinger tells us that inventors know how to generate and analyze possibilities. The implication of this for educators is that students need to be taught to use many methods and strategies. This section will deal with brainstorming, probably the most fundamental strategy for generating ideas.

Use PLTS #9 with this section in order to teach about and self-assess how to generate and analyze possibilities.

Brainstorming, which was introduced by Alex Osborn in his book *Applied Imagination*, is an integral part of creative thinking. The purpose of the process is to generate numerous ideas while deferring judgment. It can be used by an individual or a group of people. When brainstorming in a group, a topic or a question is introduced and each participant is encouraged to make many verbal responses. A designated recorder writes down all ideas.

To conduct a successful brainstorming session, four rules need to be followed:

1. <u>NO CRITICISM ALLOWED</u>
   Since there is a natural inclination to judge ideas immediately, students need to be taught to defer judgment. Individuals should not criticize or praise the responses of others or engage in positive or negative self-talk during the brainstorming session. Another form of criticism to avoid is any body language that expresses judgment. Each response should simply be recorded as given and written large enough for everyone to see.



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2. **WORK FOR QUANTITY**
   Osborn believed that quantity breeds quality. People must experience a brain drain (get all the common responses out of the way) before the innovative, creative ideas can surface. Students should be taught to generate many ideas because the later ideas are frequently the most original. Originality seems to begin "flowing" after 15 to 20 options have been generated.

3. **HITCHHIKING WELCOME**
   Hitchhiking occurs when one member's idea sparks a modified or elaborated response from another participant. It is a way of making creative connections. Hitchhiking can also help build team work and group support.

4. **FREEWHEELING ENCOURAGED**
   Freewheeling allows the student to produce the wild, crazy, fun ideas that often result in a solution to a problem. These wild ideas frequently provide a foundation for ideas that are quite original. Osborn said that it is easier to "tame down" a crazy idea than it is to improve a poor one. In addition, these wild ideas can often be the springboard that someone else in the group can use for a very unique idea.

Another important aspect in the use of the brainstorming technique is an environment that encourages people to feel comfortable and relaxed. Individuals must feel confident that they can risk sharing ideas. It is essential in any brainstorming session that participants understand and adhere to the rules. These rules could be displayed in the classroom on a poster like the sample on the following page.

Students need to be provided ample opportunities for practice to insure that they understand the brainstorming process. The following is an example of a format which may be used to teach this technique to students: (Read to the students.)

One evening after school some of your friends and you are waiting to play soccer on the playground at your school. Jim was supposed to bring the ball. He was the last one to arrive and forgot to bring his ball. If anyone goes home to get a ball, there will not be enough time before dinner to play a game. All of you really want to play soccer. Name the ways you could solve this problem.

After sharing this situation with the students, call for verbal responses. Be sure the recorder writes down all responses just as they were stated. No attempt should be made to edit or correct them. Knowing when to close a brainstorming session is very important. The session should last as long as the children are actively producing responses. Remember that last minute answers are often the most creative. The shy, hesitant child may slip in ideas at the last second, too.

Brainstorming can be teacher led with the entire class or student directed in small groups. While teacher direction is best for introduction of brainstorming, once the students have learned the process, small groups provide an opportunity for effective independent practice.

BRAINSTORMING RULES

NO CRITICISM ALLOWED

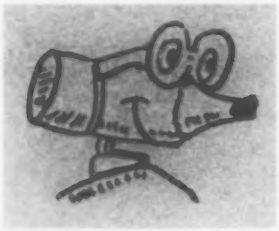
WORK FOR QUANTITY

HITCHHIKING WELCOME

FREEWHEELING ENCOURAGED

85

The following pages contain activities that can be used as teacher directed lessons or placed in a center for students to use individually or in small groups. Students may also create their own situation cards.



Use PLTS #4 with these activities in order to help identify students who know how to generate and analyze possibilities.

A blank card is provided for duplication, so that teachers or students may create original activity cards. Designing new cards allows the students an opportunity to demonstrate their understanding of the activity and gives them the chance to write brainstorming cards about topics that are of personal interest. The steps below could be followed to help students learn how to develop original brainstorming activities:

1. Utilize the brainstorming process with the students to generate problems that might be used for a situation card.
2. Discuss the alternatives suggested.
3. Select one problem with which to work.
4. Write an activity card based on the problem. This may be done with the entire class or in small groups. Good brainstorming tasks should...
   - be truly open-ended
   - contain a clearly stated problem
   - require participants to construct responses, not merely recall them
   - make it clear that many, varied, unusual responses are desired

86

We go to a very modern school. Our principal has upgraded all equipment to current technology. All crank pencil sharpeners have been replaced by electric ones. The problem is that this afternoon all electricity in the building is off, and you just broke the lead out of your last sharpened pencil. Name the ways you can sharpen your pencil so you can complete your writing assignment before you leave school.

It's a stormy Thursday afternoon and your mother has asked you to watch your little sister, Sally, while she prepares dinner. Sally is very scared of thunder. You must find ways to entertain her so she won't cry everytime she hears the thunder. Name the things that you and Sally can do in the house that will take her mind off the storm outside.

87

A really fun thing to do after a rain storm is to play in newly created puddles. Did you ever stop to think about the puddle itself? For example: Why did it form right where it did? Where does it go when it disappears later in the day? How many rain drops did it take to make the puddle? That last question is one that has always held my curiosity. Help me out. List the ways I could determine how many raindrops are in a puddle.

One of the things you must do each week to earn your allowance is to dust the house (the entire house!). It's the job you like the least in the whole world! In order to get out of this dreaded chore, you must convince your mother that it would be more advantageous to keep the dust and use it in some way. Make a list for your mother of the things you could do with the dust.

Have you ever awakened in the morning frustrated because you know you had a really neat dream the night before and can't remember it? This happens frequently to a lot of people. In fact scientists who study sleep patterns and dreams tell us that an individual has many dreams each night. List the ways you can think of that could be used to help people remember their dreams.

You are standing in the check-out line at the grocery store with your family. It's a long line and it seems like you've been standing in it for hours. To make matters worse your favorite television show of the entire week begins in exactly 15 minutes. Having to spend time waiting in long lines makes a lot of people angry. Help them out by naming things that could be done to solve this problem.

89

Your favorite summer pastime is to spend hours swimming and playing in the sand. This morning when your father was going to work, he dropped your mother, brother and you off at the beach. When your mother reached into her bag for the sunscreen, she realized she had left it at home. She told you that because you sunburn so easily, you would have to sit under the umbrella all day. Tell her the things you can do to keep from getting sunburned so you can enjoy the beach.

For a long time you have wanted a dog. Your parents have always told you that pets are too much trouble. You need to convince your mom and dad that rather than being trouble, dogs can really help the family. Compile a list of the advantages of pet ownership to give to them.

How many times have you been riding down the road with your family and noticed one shoe lying along the highway. Have you ever wondered how that one shoe got there? Make a list of the ways that shoe could have landed right in that place.

or

Name the things you could use that one shoe for if you stopped and picked it up.

You have been asked by your local fast food restaurant to serve on a student advisory committee. The owners want to add new sandwiches to their menu. They're seeking unusual sandwiches that people your age would really enjoy. Make a list of all the neat sandwiches that could be considered by the restaurant. Remember: Freewheeling is encouraged!

91

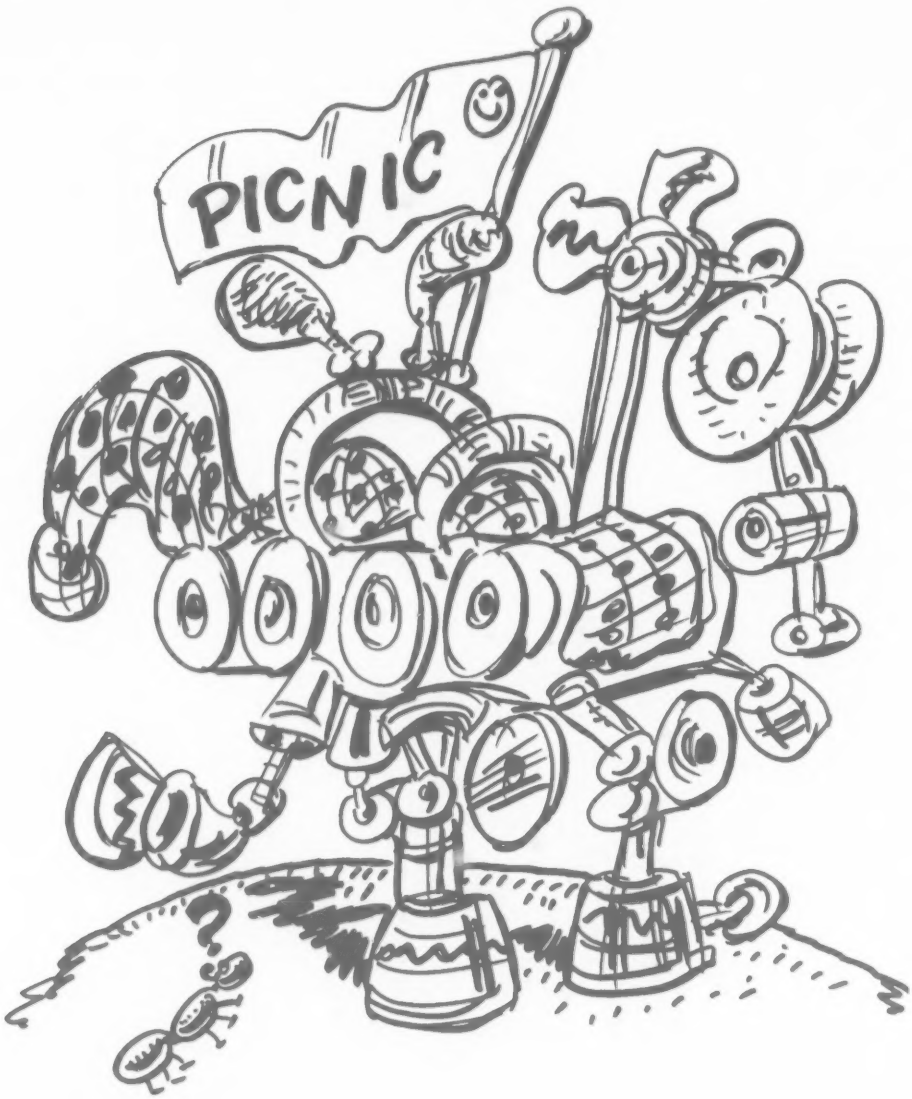
Many ideas from which you can create your own prompts are listed below.

- things you would say to the principal of your school
- ways to keep from falling on ice
- ways to count to 100
- different ways to greet someone
- reasons to remain in school
- different methods for telling time
- things you would do if you didn't have a television
- rules that should be written
- ways to break an egg
- ways to get to Australia
- ways to keep from coughing
- ways to clean teeth
- how would you communicate in a foreign country
- excuses for not turning in your homework
- new kinds of cereal
- things you could do to get yourself on television
- new holidays that you would like to celebrate
- ways to mail something without an envelope
- things you would do if you were teacher for the day
- changes we would have to make if it never rained again
- unusual uses for sand
- changes to make a more functional school desk
- kinds of birthday parties
- unusual ways to recycle your empty milk carton from lunch

92

LET'S HAVE A PICNIC!!!

Select one of the words listed and brainstorm other possible uses. Practice with as many words on this page as you wish. Choosing your own "picnic" words for this activity is fun, too!



paper plates
paper cups
straws

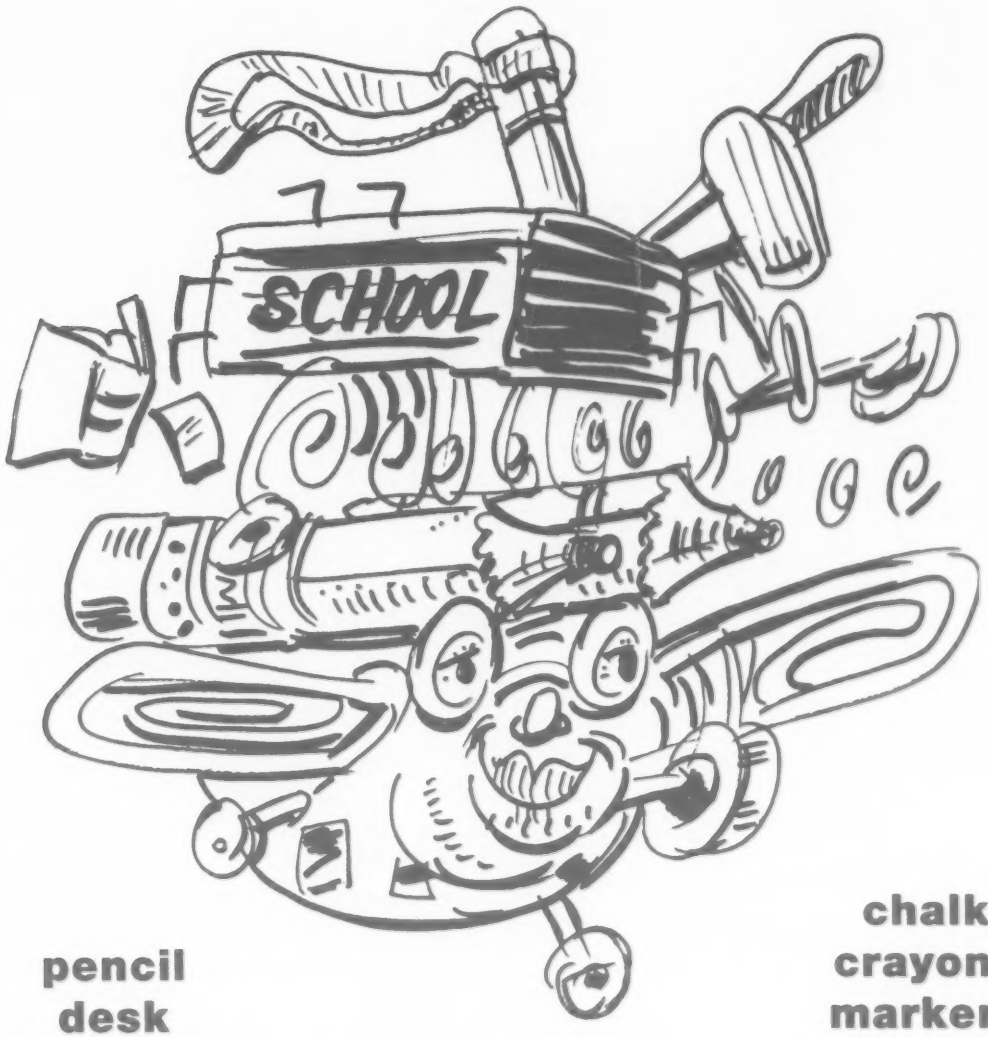
basket
napkins
blanket

aluminum foil
plastic wrap
umbrella

cold drink cans

SCHOOL DAYS

Select one of the words listed and brainstorm other possible uses. Practice with as many words on this page as you wish. Choosing your own "school" words for this activity is fun, too!



pencil
desk
lunch tray
eraser

staples
paper clip
rubber band
cellophane tape

chalk
crayons
markers
paint brush

94

PLAY BALL!!!

Select one of the words listed and brainstorm other possible uses. Practice with as many words on this page as you wish. Choosing your own "sports" words for this activity is fun, too!

cap
tennis racket
helmet
goal
coach

scoreboard
hockey puck
spectator
ping pong balls

shoe laces
sweat socks
skateboard
netting
bat
referee

BEST COPY AVAILABLE

95

GARAGE SALE!!!

Select one of the words listed and brainstorm other possible uses. Practice with as many words on this page as you wish. Choosing your own "garage" words for this activity is fun, too!

magnets
levers and pulleys
keys
hub caps
gears
pegboard

wheels
old tires
cardboard boxes
fruit jars
old newspapers

springs
nuts and bolts
hinges
dowels

BATHROOM STUFF

Select one of the words listed and brainstorm other possible uses. Practice with as many words on this page as you wish. Choosing your own "bathroom" words for this activity is fun, too!

hooks
rugs
mirror
shampoo

bathtub
towel
bubble bath
shower curtain

combs
brushes
cotton balls
tooth brush
cotton swabs

97

THE KITCHEN COUNTS

Select one of the words listed and brainstorm other possible uses. Practice with as many words on this page as you wish. Choosing your own "kitchen" words for this activity is fun, too!

spaghetti
chair
table
silverware
cork stoppers
paper towel roll

lemon peel
cup
ice cube
pots and pans

microwave
dish drainer
toaster
blender
egg beater

References

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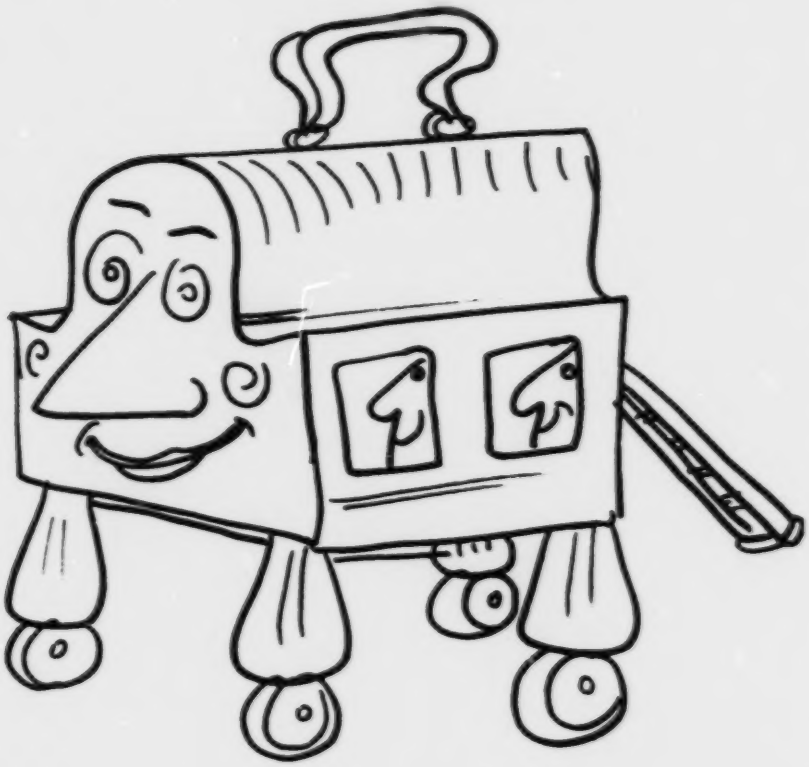


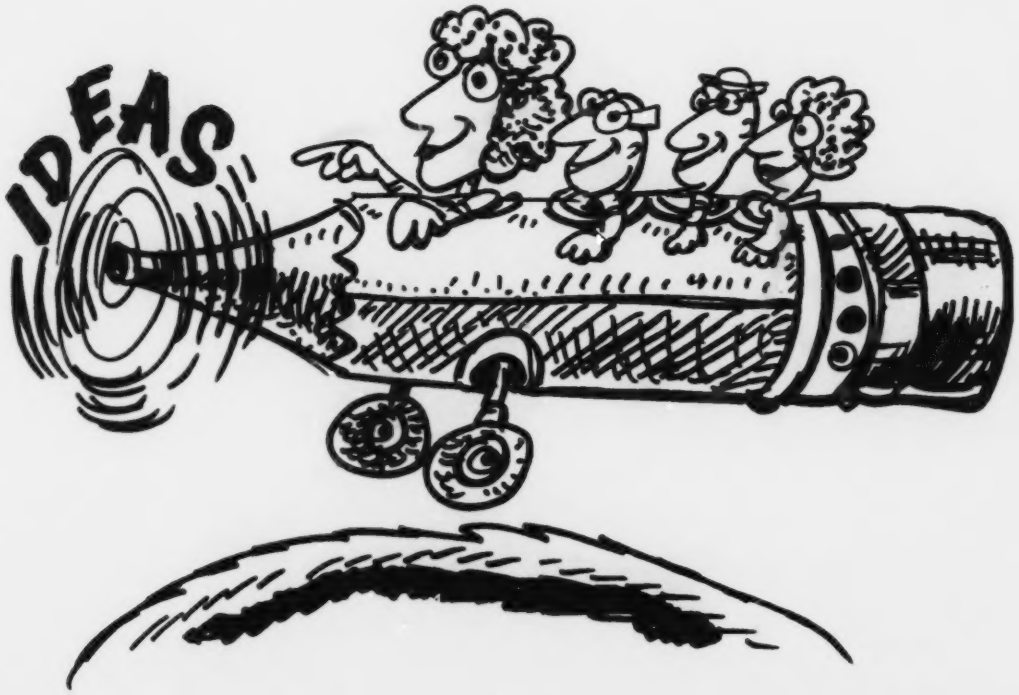
Drawing On The Inventive Mind

Jon Pearson

Jon Pearson

Jon is an internationally known speaker and thinking skills consultant. He has performed on stage, television and in the schools; and has worked with half a million students, teachers, parents, and administrators across the United States, Canada and Asia. He has been a classroom teacher, a cartoonist for the Oakland Tribune, a lecturer, an actor, a piano mover and an "extra" for the New York Metoropolitan Opera Company. Also, he has been a truck driver, a mailman, a librarian, a dishwasher and an ice cream salesman.

The United States government selected him to tour schools throughout the Orient. As a motivational speaker for business and schools he has addressed many state and national conferences. He received from the United States Patent Model Foundation's national "Creativity Conference for Educators" the highest workshop ratings in its history. Jon is on the Board of Directors of the National Inventive Thinking Association. As a third grader once said: "He is one of the nicest men in the world."



Drawing On The Inventive Mind

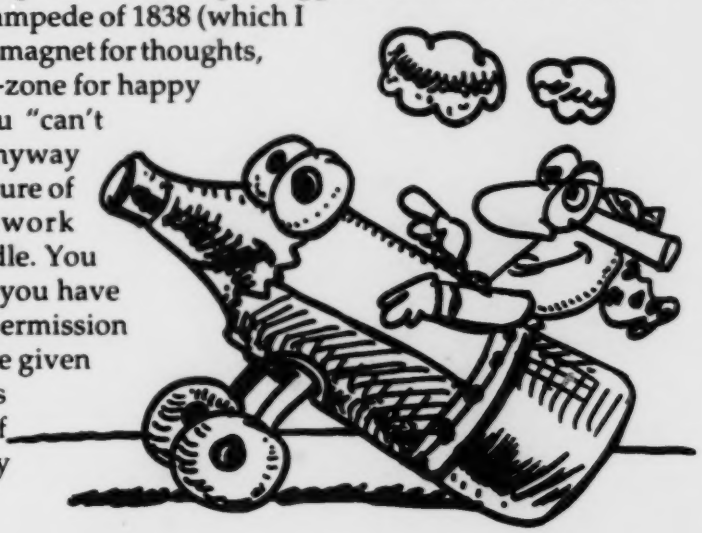
Jon Fearon

Most people feel they can't draw. Maybe when they were young someone said the deer they drew looked like a tea bag on popsicle sticks and they "decided" they would never be an artist, ever. Most little children, however, LOVE to draw and then around fourth grade children tend to divide into "class artist" and "can't draw." They switch from a "DO IT AND SEE" attitude to a "DON'T DO IT UNLESS YOU CAN DO IT RIGHT" attitude. This attitude seeps into many areas of life. People start thinking they are either "creative"or not creative.

I try to stop wondering whether or not I am creative and start focusing on how I might be one percent MORE creative than whatever I am. Along these lines, I find I can be a little more creative doing anything, including opening doors or doing dishes. Also, I stop thinking of drawing as just making pictures and start thinking of it as a language for generating, organizing, and retaining ideas.

I like to think that even a "failed" drawing may be loaded with personality, individuality, and accidents—the stuff of creativity. So what if someone said your picture of a deer looked like a tea bag on popsicle sticks—a whole new invention may arise: perhaps popsicle tea, leg coolers for horses, tea scented pantaloons. Who knows? I know this—that if you switch from (self) critical to curious—from how the picture looks to what it suggests—whole worlds open up. Basically, the world of the child opens up—the creative, inventive world that is inside us all the time whether we know it or not.

Older children often think they have to know what a picture is. A picture is always many things at once. Your tea bag on popsicle sticks might suggest an aerial view of the Great Lakes and the great deer stampede of 1838 (which I just made up). Drawing, I find, is a magnet for thoughts, a focus for talk, and a permission-zone for happy errors. Let's say, you think you "can't draw"and you go to the board anyway and draw this huge, lopsided picture of a bumblebee with the homework assignment written down the middle. You have done more than a picture—you have given everyone else in the room permission to NOT be a great artist. You have given them permission to "fail." This may be the highest permission of all since with it you can do virtually anything.



I give you permission to "fail" like crazy on the following fail-proof exercises. They come from a book I wrote, *Drawing on The Inventive Mind*, after working with a few hundred thousand students. The techniques are not "just" about drawing, but practical ways to mix drawing, talking and writing. After doing some of the activities, you may say (as one twelve year old did after a workshop): "I feel young again."

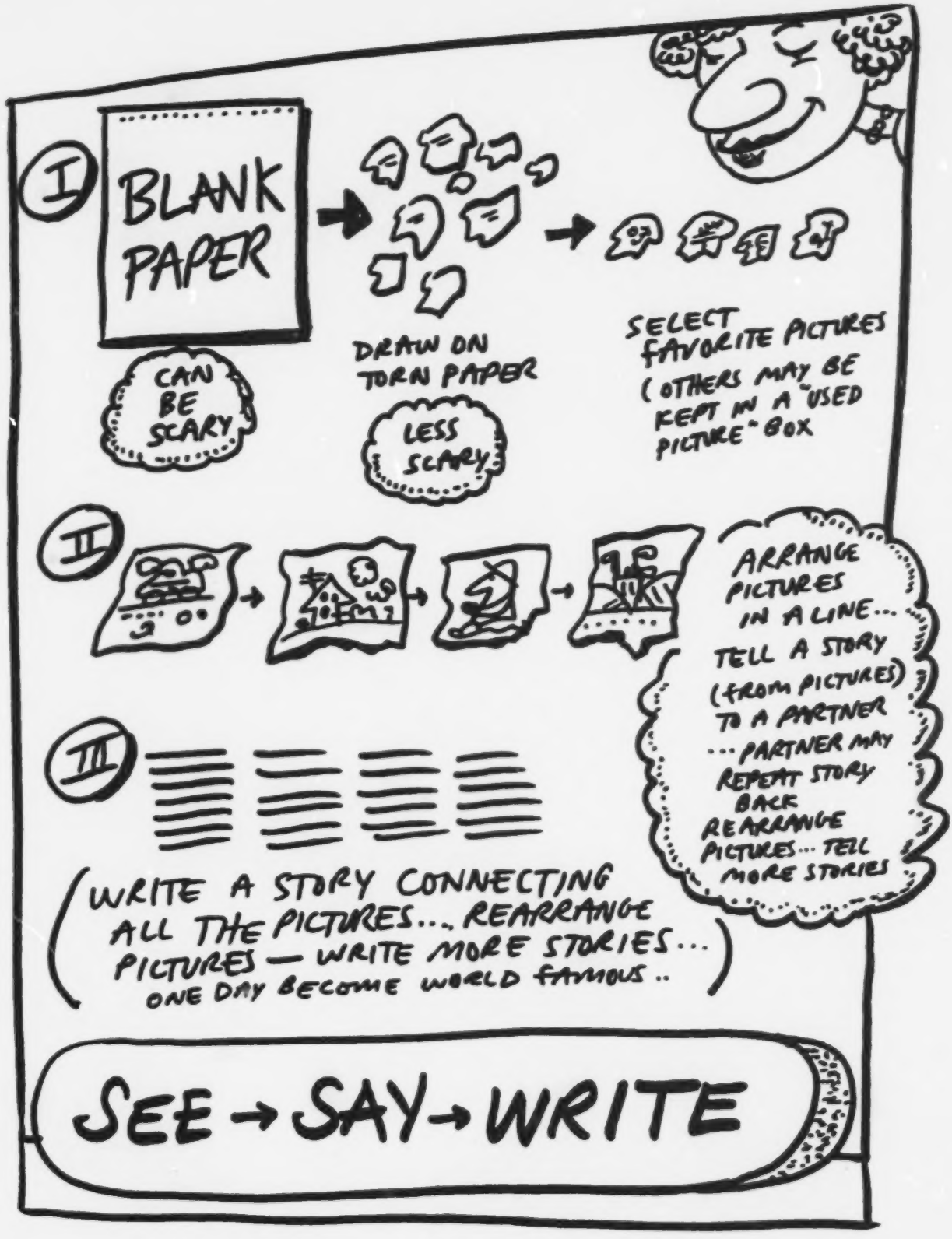
Use PLTS #4 with this activity in order to help identify students who know how to generate and analyze possibilities.

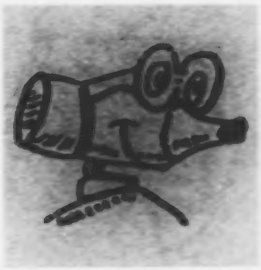
PICTURE PILES

Have students tear up a piece of paper into scraps. Often students are afraid of blank paper (it reminds them of the last time they had to draw or write and maybe didn't do so well). Paper can also look a little formal, such straight edges; it seems to say, "Be creative, just don't make any mistakes." So, the act of tearing paper can change the format and reduce performance stress.

Students pick a scrap, draw a picture, turn the scrap over, pick another scrap, do another picture, and use up as many scraps as possible, working fast. They can go back later and add backgrounds and details to the individual pictures. Then, the students pick out five or so pictures from their pile and sequence them and tell a story connecting the pictures. The students can partner up and tell their stories to a listener who, at the end, must repeat back the story as best they can.

Students can also write stories on torn paper and splice them together. Afraid of writing a story? Write a short story (on a torn piece of paper). Students can illustrate the story on the back of the paper and sequence the pieces into new stories.

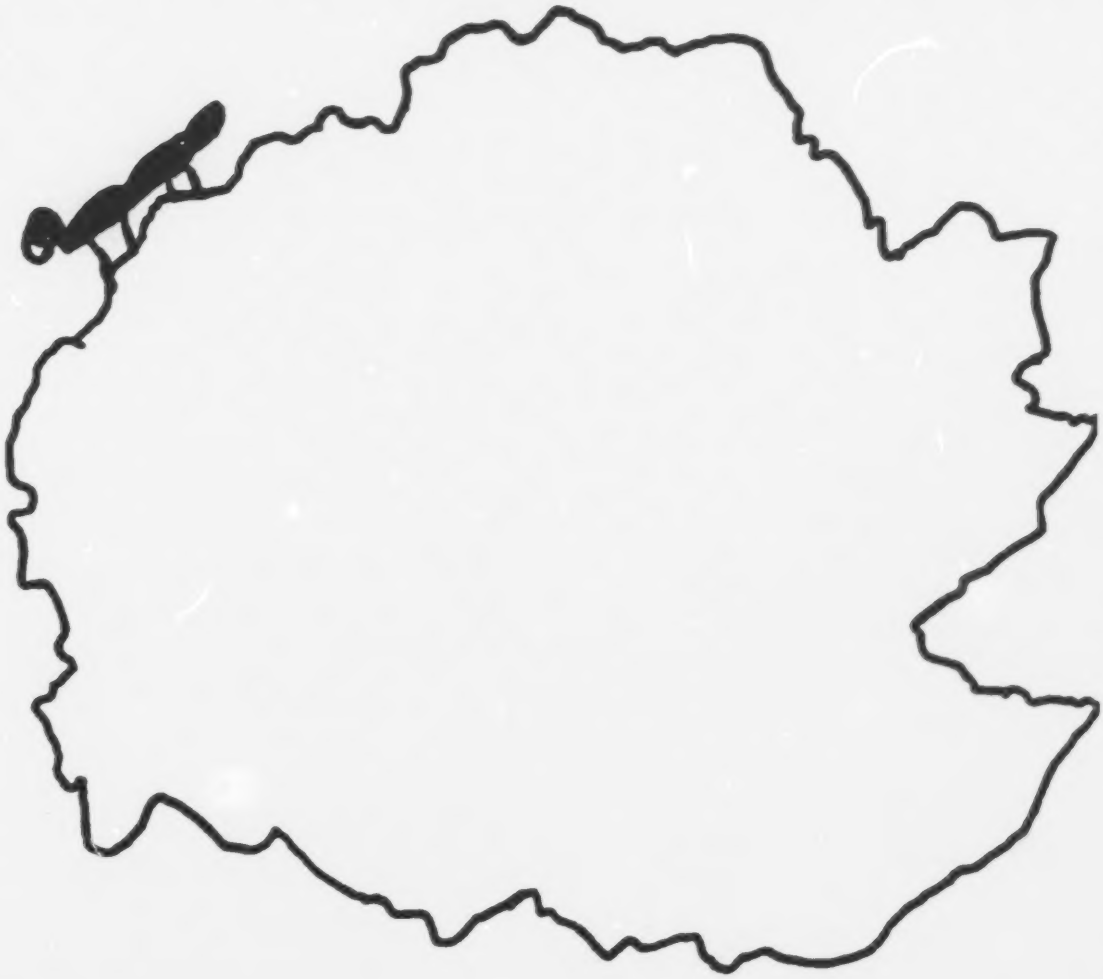

I
BLANK PAPER
CAN BE SCARY
DRAW ON TORN PAPER
LESS SCARY
SELECT FAVORITE PICTURES (OTHERS MAY BE KEPT IN A "USED PICTURE" BOX
II
ARRANGE PICTURES IN A LINE... TELL A STORY (FROM PICTURES) TO A PARTNER ... PARTNER MAY REPEAT STORY BACK REARRANGE PICTURES... TELL MORE STORIES
III
(WRITE A STORY CONNECTING ALL THE PICTURES... REARRANGE PICTURES — WRITE MORE STORIES... ONE DAY BECOME WORLD FAMOUS..)
SEE → SAY → WRITE

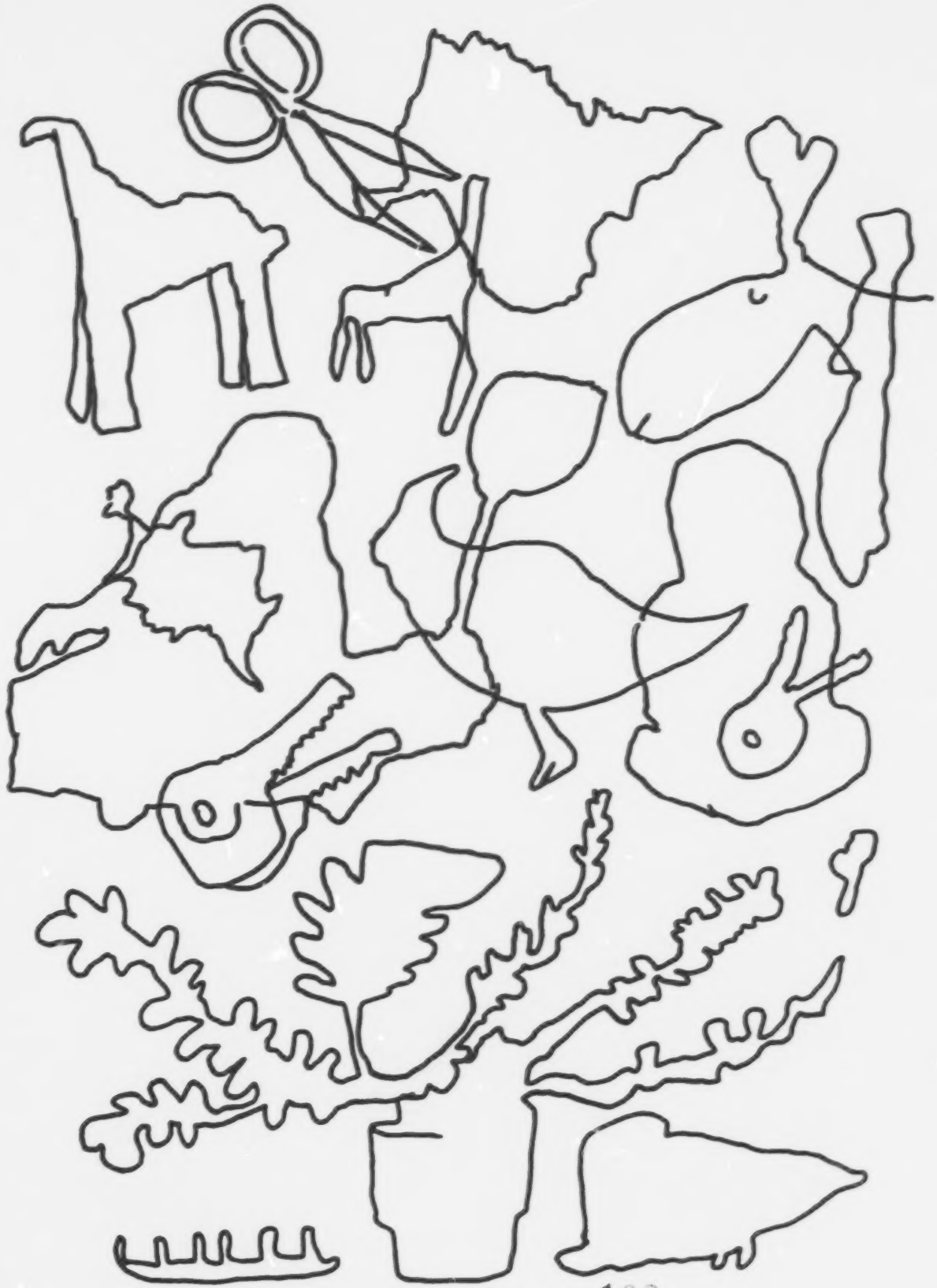


Use PLTS #6 with this activity in order to teach about and self-assess openness and courage.

"THE TIRED ANT"

Another name for this is "contour" drawing. The idea is to draw the edge or contours of objects very slowly without looking at your paper. The emphasis is on seeing the object rather than making a picture. Crumple a piece of paper and hold it to the side of you so that you can't see it and the drawing you're making of it at the same time. Draw very slowly, as if you were following the journey of a tired old ant, walking around the edge of the crumpled paper. Your eye or hand will want to race ahead, but don't let it. Anything complex may be drawn (leaves, hands, etc.). Straight lines are boring for the "tired ant." All of this helps students to see and think more closely and clearly.





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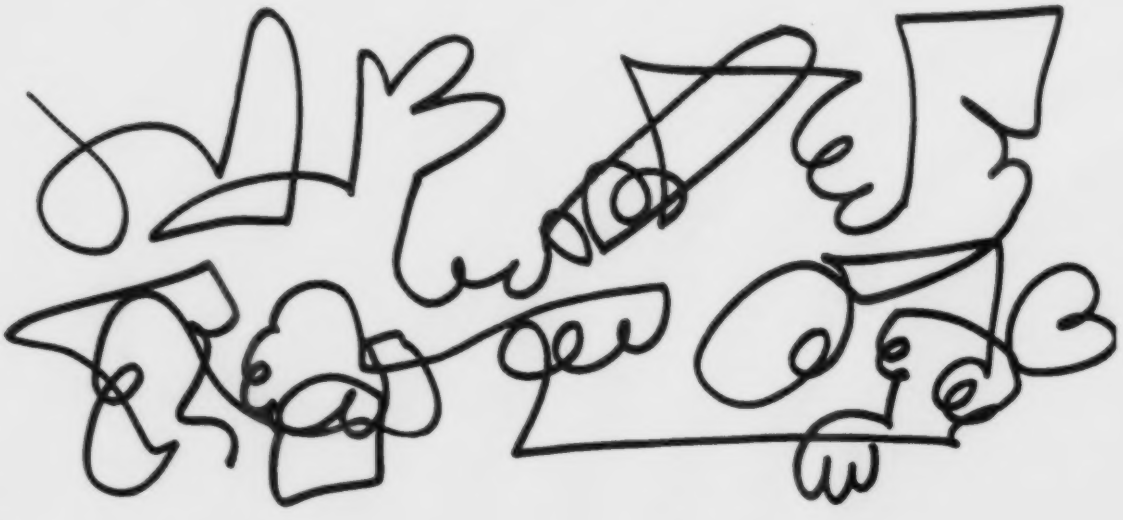
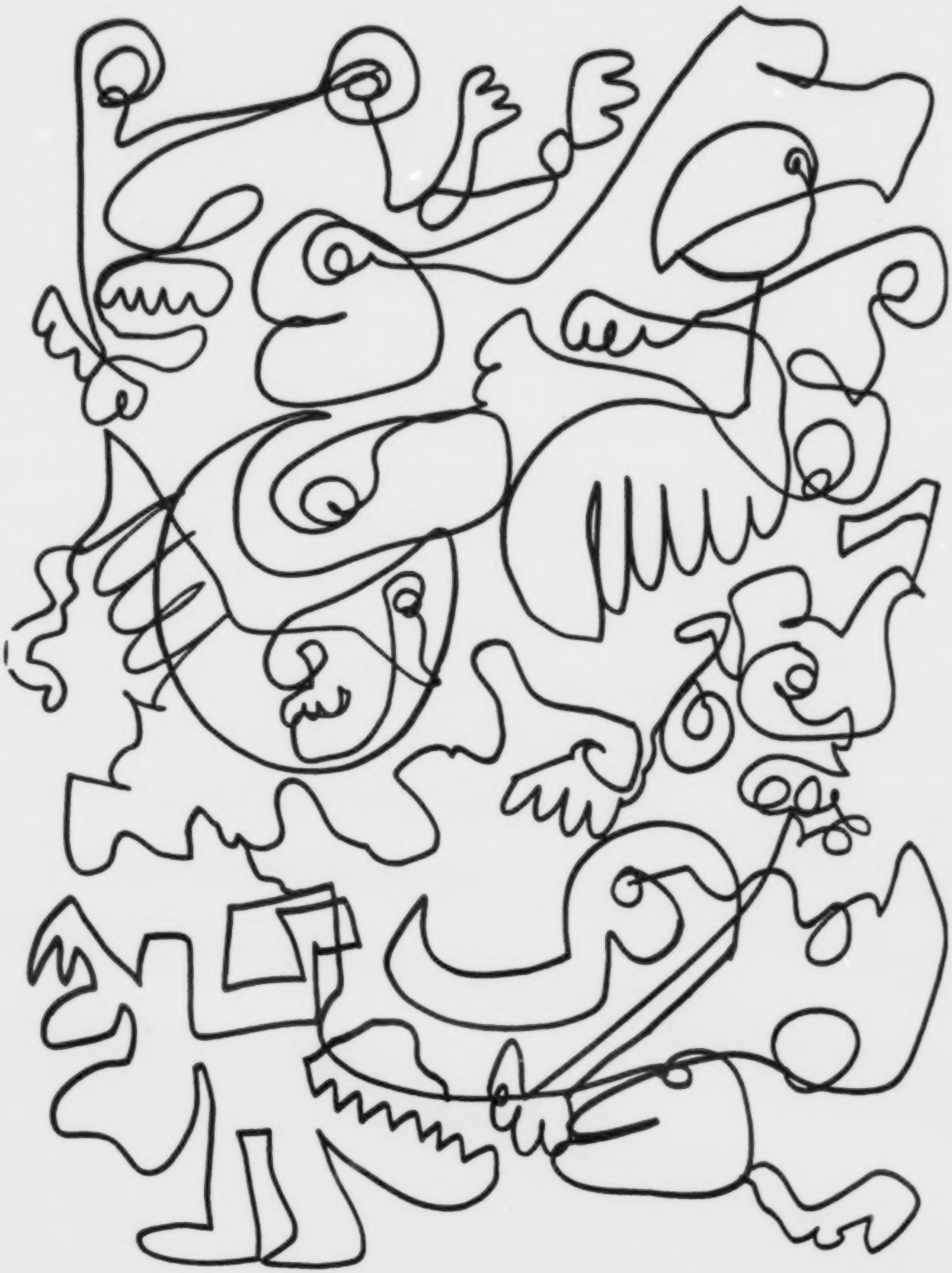
Use PLTS #7 with this activity in order to teach and self-assess listening to their "innervoice."

NONSTOP DRAWING

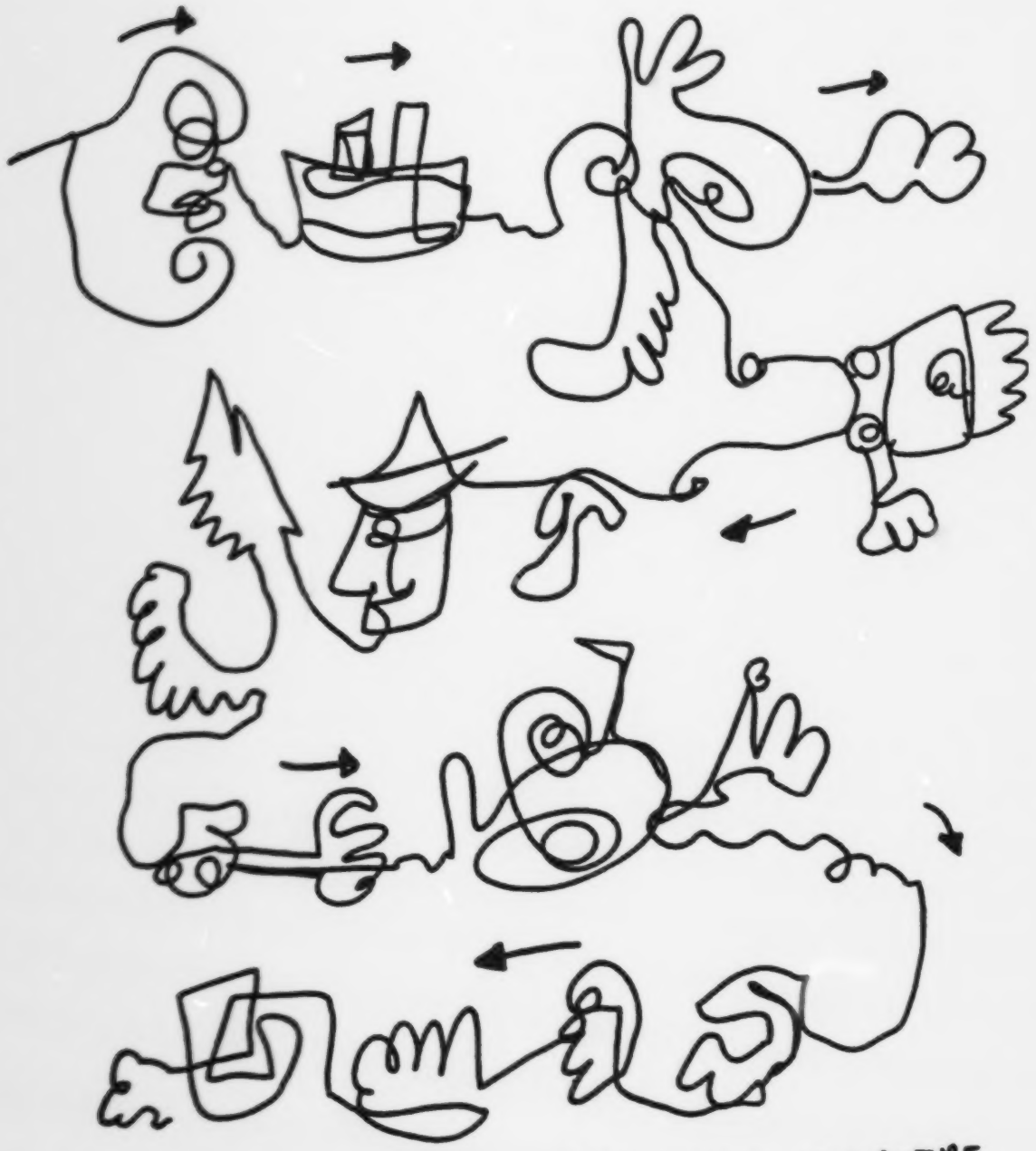
Younger students just draw. They seem to go by the rule: "Do it and see." They let their hand move and their pictures give them ideas for more pictures. Later in school the rule seems to become: "Don't do it unless you can do it right."

Consequently older students tend to stare at the paper until they have an idea for a picture (usually nameable). "Aha, I'll draw a truck." etc. Their pictures are usually word-bound, not allowing pictures to emerge from pictures (right brain). So, give students paper and let them draw whatever they like with only two rules. Once you start drawing you can't stop and, secondly, you can't lift your pencil off the paper. You can go anywhere you like on the paper, you just can't lift your hand or stop. The "class artist" may hate this but students generally love it and it's a great warm-up. Have them draw for a couple minutes. Next, have them do the same exercise only this time call out things at intervals that they must immediately draw, i. e. if Jim is doing a motorcycle and you call out "buffalo," he can't finish the motorcycle first—he has to make it INTO a buffalo or move his hand elsewhere on the paper and draw a buffalo. It gets students out of ruts. They can't draw the same old things and they HAVE to keep drawing. When you call items out start simple (baseball, flower, watermelon, back of Bugs Bunny's head...) and get complicated. Have students do an aerial view of Fort Knox, the inside of a whale, the Caribbean coast, a horse (with their eyes closed), their mother on a camel. The hand leads the head and you get to see what you don't know as well as what you do. Students realize listening itself is a journey and not something they just do with their ears.





START HERE.
TELL A STORY CONNECTING ALL THESE
THE DRAWING BECOMES THE "OUTLINE"
FOR TALKING AND WRITING
NOW GO BACK THE
OTHER WAY... STOP ANYWHERE
AND ELABORATE.



THE DRAWINGS NEED NOT MAKE SENSE... IF A PICTURE DOESN'T LOOK EXACTLY LIKE SOMETHING IT CAN SUGGEST LOTS OF THINGS...

ADD-ONS

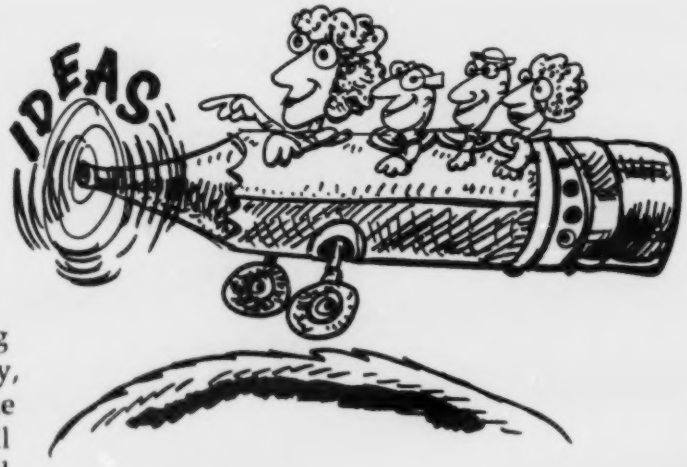
If a student does a pretty good drawing of a bicycle, let's say, she/he doesn't want to add on to it for fear of messing up what's already been drawn. Many students later in elementary school start doing what I call "subtraction" drawing. They only draw (or for that matter write, say or do) what they are sure of and then they erase away at their paper to get the picture outside their head to look like the one inside it. It can be a very frustrating process.

So, I go to the board and draw a very timid little picture of an animal or a machine or a plant and begin adding to it—arms, cranes, shoe strings, bridges, Donald Duck's lunch box, hotels, rope ladders, dresses, flower beds, airplane launchers, anything my hand thinks up—a whole profusion of things not having to make any sense at all. The drawing grows and grows like some huge bacteria (no erasing at all, just adding).

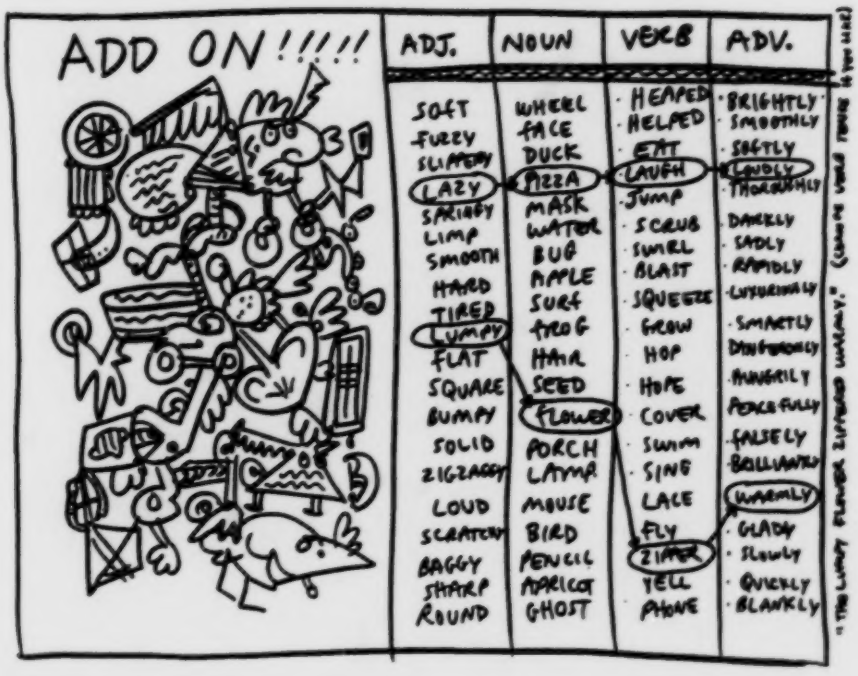
I then have the students make their own ADD-ON drawing. The only rule is they have to fill their whole paper (not by being sloppy but by being prolific). I sometimes add the rule that they can't repeat anything in their picture (i. e. if you have one flower that's IT for flowers). The idea is to go for fluency and flexibility: muchness and variety. Students, even students who think they are poor "artists," often produce these amazingly complex drawings. Everything sort of grows out of everything else—a race car might come out of a palm tree, a palm tree might have a lady's face and so on.

The drawing process is a thinking process. What the students are really doing is making visual associations, metaphorical connections: airplane is related to shoe, is related to truck, is related to the Baja California coastline, is related to ant feet, etc. Students who CAN associate visually can HEAR more of what you say to them because they can SEE more of it and can go far beyond what you literally say. So, when you say, "Daniel Boone stepped onto the shore," while nonvisualizers may only have a vague image of some guy getting out of a boat, rapid visual associators may see a canoe and Indians downstream roasting raccoons, etc.

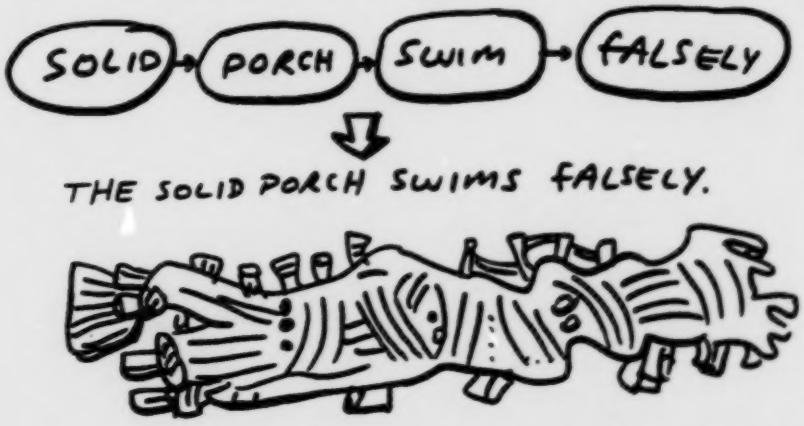
Drawing, by its nature, builds visual ASSOCIATION and fosters writing and speaking. Have the students partner up and, using their ADD-ON as an "outline" create stories. Have a talker and a listener. The listener, after about a minute or two, has to repeat back what the talker said. If the listener "repeats" something that wasn't said, the talker can say, "Great, I forgot to mention that." The partners then reverse roles. This all builds fluency, flexibility, and confidence.



You might also have students divide a large piece of paper in half and on one side do an ADD-ON and on the other side make four columns and list all the adjectives, nouns, verbs and adverbs they "see" in the drawing.

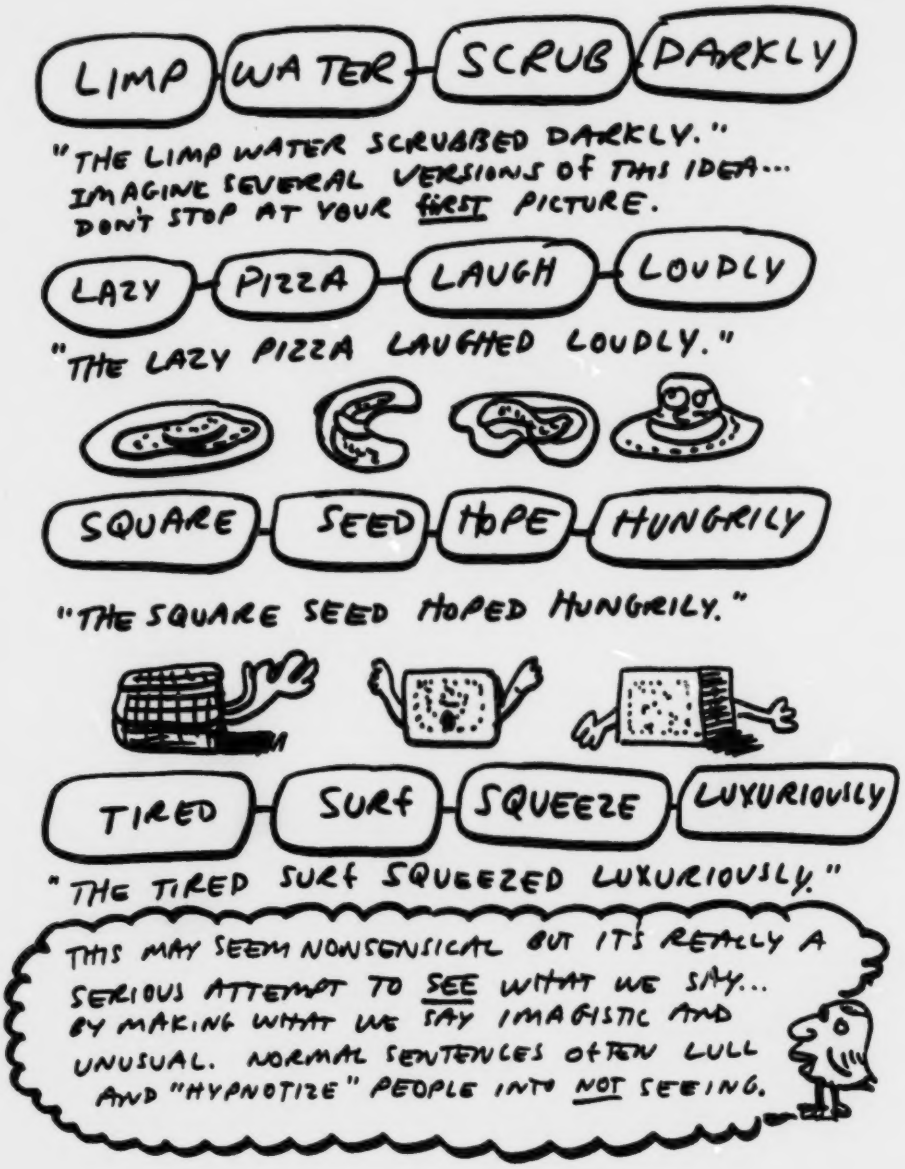


I have them start with the noun list. They list all they can see or imagine. If something looks like a cross between a cow, a washcloth, a diaper, a stack of books and some angel hair pasta, you have LOTS of nouns. Then, the students ask themselves what it would feel like touching the washcloth, the cow, etcetera...and what can a cow do, a washcloth



FEEL FREE TO CHANGE THE NUMBER OR TENSE OF THE VERB... THEN - MAKE UP AN ILLUSTRATION. IT'S A REAL MIND TWISTER. STUDENTS WILL LEARN TO SURPRISE THEMSELVES.... HAVE WHOLE CLASS TRY DIFFERENT DRAWINGS FOR A SINGLE SENTENCE.

do, a plate of pasta do? You would be surprised. Go beyond the literal. A plate of pasta might "beg," or "entice," or "shumble about" (make up your own words if you like). And for adverbs, I just list appropriate "ly" words. Finally, students make random four number combinations: 4-3-9-7 and connect adjective #4 with noun #3, and verb #9 and adverb #7 and arrive at a sentence like: "The green sun swirled secretly."
The whole class can put up a big sheet of butcher paper and make a group ADD-ON and



then pull out columns of words (no repeating of words, i. e. you can't have "truck" five times on the list, so students must read the entire list before adding words). Then by combining random words students will effortlessly devise some poetic and intriguing sentences. Have fun!

BEST COPY AVAILABLE

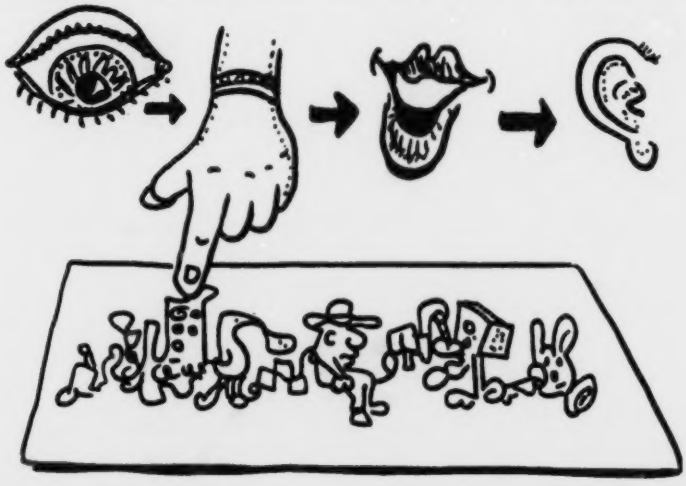
TALKERS AND LISTENERS

Research shows that if you involve hands and mouths in an activity, learning increases enormously. Drawing and writing involve hands and talking uses the mouth. I tell students if they want to be "successful" in the modern world there are two things they must learn to do well: TALK and LISTEN.

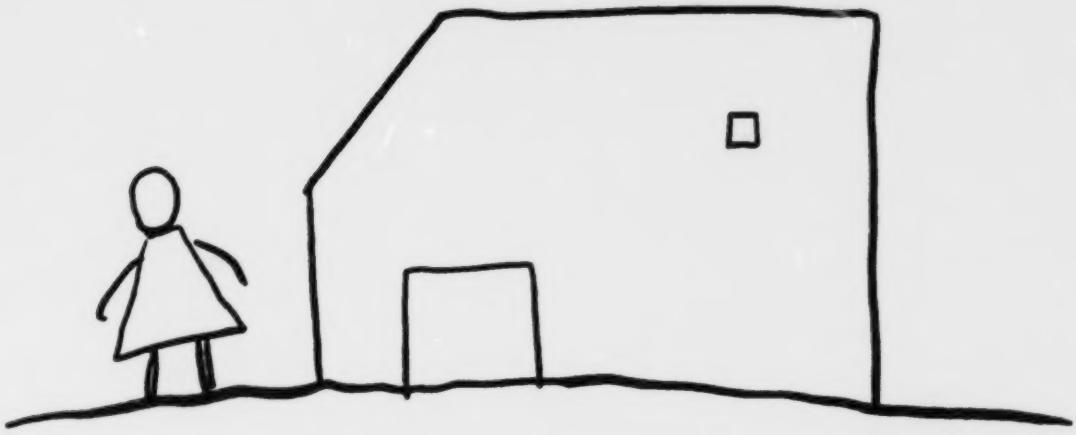
An excellent way to get students talking is from their drawings (even if they think they "can't draw a straight line"). After drawing, have students partner up (talker and listener). The talker describes or explains or in any way "unpacks" their drawing while the listener listens with a fist. Every time the talker stops talking the listener puts out a finger. Five stops and the listener's hand comes up and you, the teacher, can see who needs help. The listener's hand goes up, also, if the talker just isn't talking at all. Naturally, you don't want to force students, but try to get the students talking from their pictures. Pictures provide details, details provide talk. If students can't think of what to say, they can talk about ANYTHING, "grapefruits," "their trip last summer to Alaska" (triggered by something in their drawing)...and so on. After about a minute or so, the talker stops and the listener then repeats back all that was said as best as they can. The listener, while recalling, can stop, recall in any order, and if she/she says something that wasn't in the story, the original talker may say, "Thanks, I forgot to mention that." Everyone succeeds.

Have students, while talking, reach into their picture, follow it with their fingers, pretend they are walking around inside it, smelling, hearing, tasting, touching, seeing things. Drawings like the NON-STOP and the ADD-ON are great "outlines" from which students can speak, but any pictures/drawings will do.

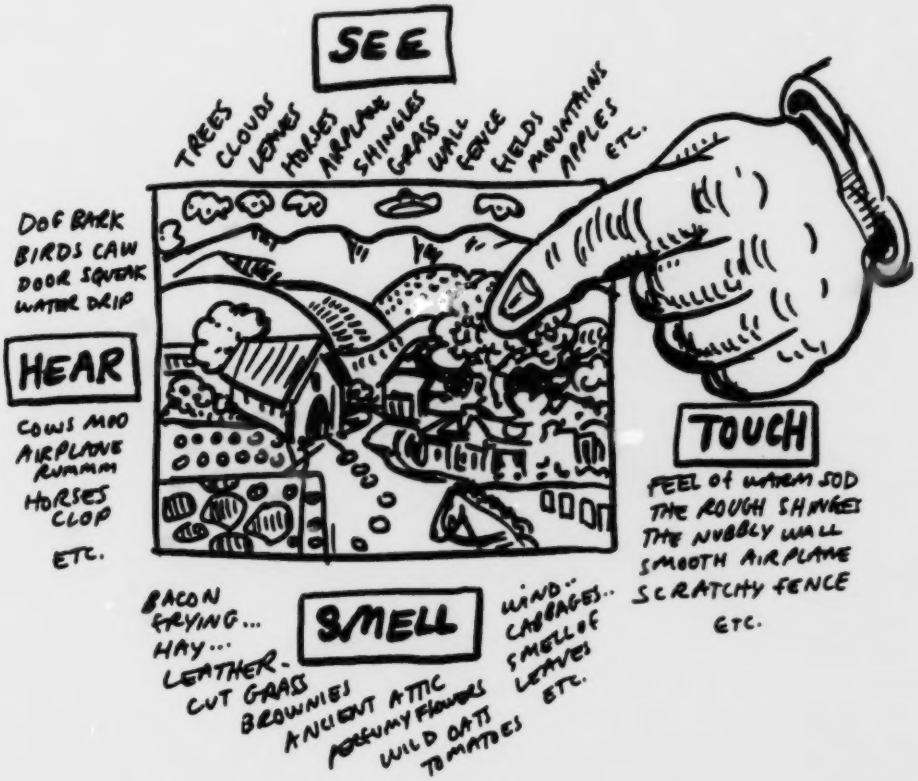
The idea of the fist and counting stops is simply to keep the students talking non-stop. It may be confusing for some students to listen AND try to be counting stops. Do what works. Listen without the fist if it's easier and remember that breathing and dramatic pauses are not "stops." Stopping is when you just can't think of what to say for more than three seconds. We are going for fluency and invention which will later appear more and more in the students' writing. Also, being listened to and recalled is extremely validating, especially for some students who often feel "invisible" during the day.



MORE THAN MEETS THE EYE



The other day I was looking at a sixth grader's drawing of what looked like a barn and a lady. I thought to myself, the student didn't seem to have a lot of imagination. I said, "Tell me about the picture." I almost never ask, "What is it?" because kids think YOU know and they are supposed to guess. She said it was a house and a lady. I still thought she didn't seem to have a lot of imagination. So I asked, "Tell me what is going on a hundred feet behind the house." She rolled her eyes up and after thinking said, "There are two boys sitting on a fence." I asked what was going on two hundred feet behind the



house. She rolled her eyes up again and said there were a couple of girls ice skating. A mile away there was a bus stop. Two miles away there was a liquor store, three miles an airport and a plane landing...we went back three thousand miles and she was never at a loss. The "moral" of the story for me was: "It is often more important what students say ABOUT their pictures than what is IN them."

Drawing for most students is really a form of "note taking" and the picture doesn't end with the picture. I have students reach into their pictures and touch them. Try this yourself with a picture or photograph in a book. Comb the picture with your index finger and really imagine the feel of the things in the picture. If you are running your hand over a coil of rope or a wagon wheel or a prairie or the White House, really imagine the sensations, the smells, even the sounds. The more students can actively enter INTO pictures (theirs or others) the more they can "see" with all their senses and receive, retain and recall information.

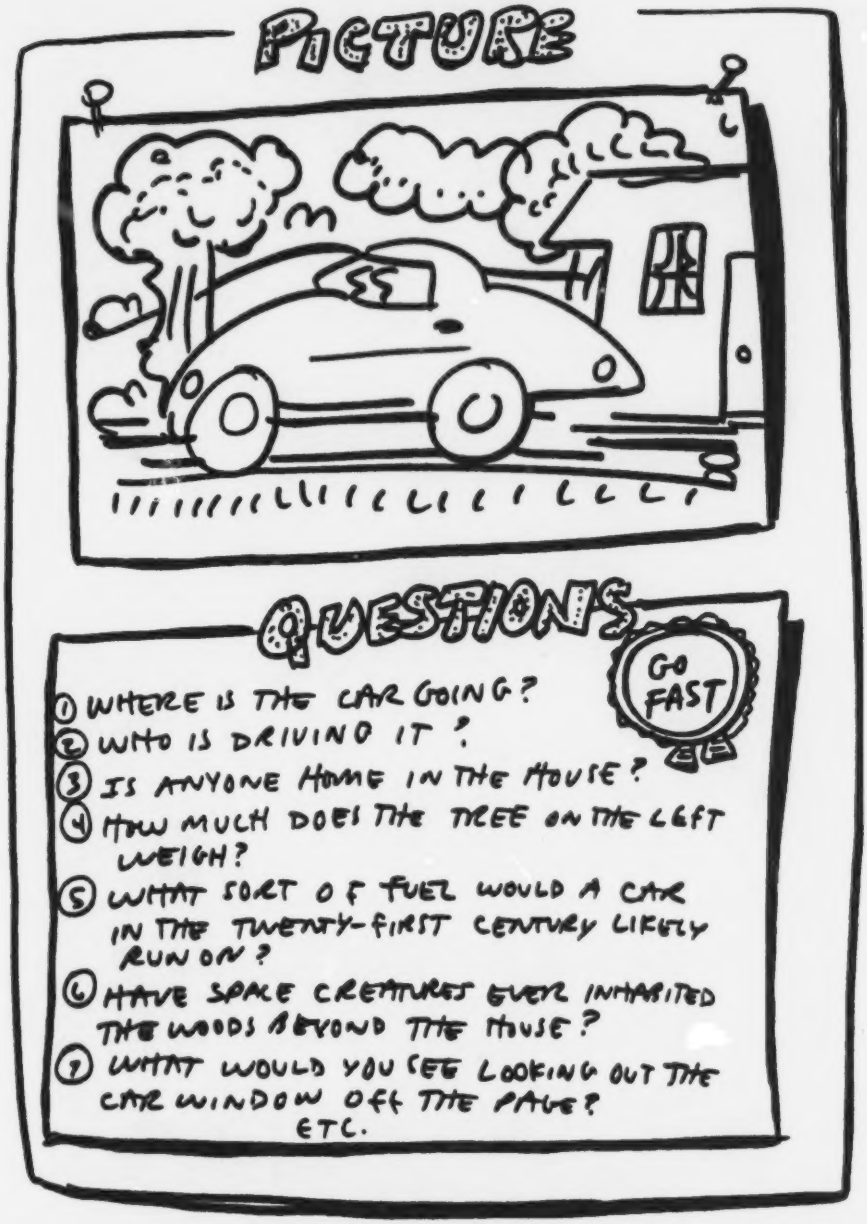
Use PLTS #2 with this activity in order to help identify students who observe skillfully and deeply.

ASKING THE PICTURE QUESTIONS

Watching TV, students can often develop a passive looking/thinking style. "Asking the picture questions" is a terrific way to develop active thinking since it involves looking at single pictures from lots of view points instead of (as with TV) looking at moving pictures from a single point of view. In time, TV can make us passive thinkers rather than active questioners.

Have your students fold a large piece of paper into squares and draw whatever they like in the first square. The idea is to generate lots of pictures from an initial drawing simply by asking questions and drawing the answers.

You will probably have to model the questioning process for your students. Pick someone's first drawing, maybe have them make a large copy of it on the blackboard. Let's say, the picture is that of a race car under a tree. In thirty seconds come up with as many questions about the picture as you can. "Who owns the car?" "Where was the rubber manufactured for the tires?" "What would a robin see of it looking down from a tree branch?" "How did it get parked under the tree?" "Does the driver's daughter like butterflies and has she ever been to Honduras?" "How do the air molecules feel trapped in the hot tires all day?" The questions can go

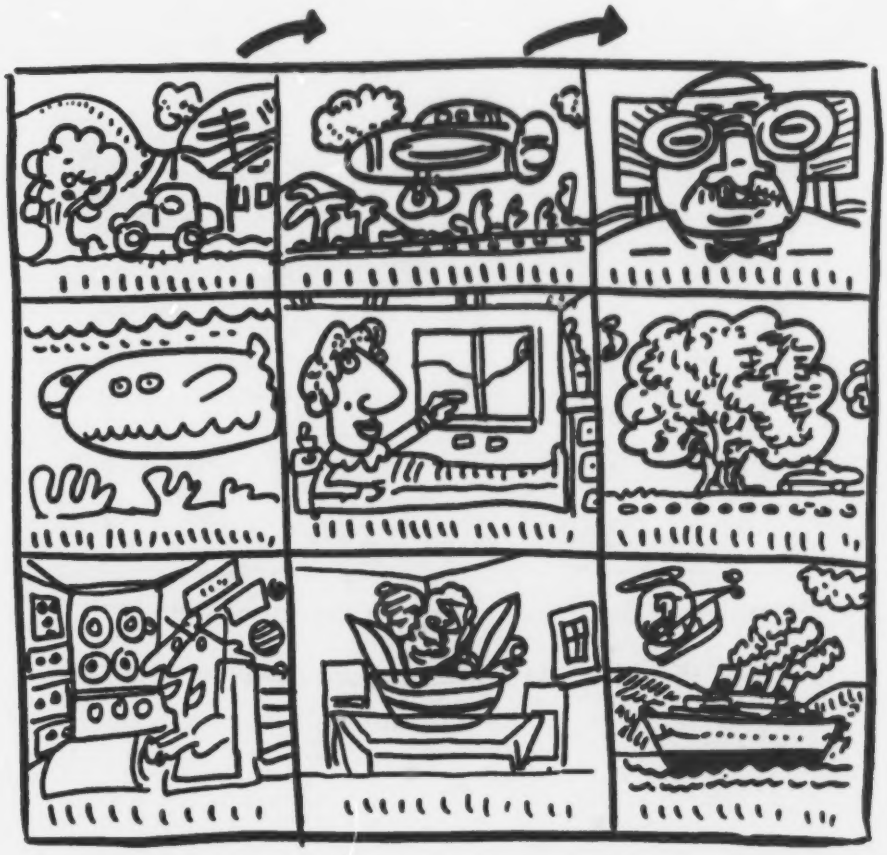

PICTURE
QUESTIONS
GO FAST
1 WHERE IS THE CAR GOING?
2 WHO IS DRIVING IT?
3 IS ANYONE HOME IN THE HOUSE?
4 HOW MUCH DOES THE TREE ON THE LEFT WEIGH?
5 WHAT SORT OF FUEL WOULD A CAR IN THE TWENTY-FIRST CENTURY LIKELY RUN ON?
6 HAVE SPACE CREATURES EVER INHABITED THE WOODS BEYOND THE HOUSE?
7 WHAT WOULD YOU SEE LOOKING OUT THE CAR WINDOW OFF THE PAGE?
ETC.

anywhere. Questions open the mind. Go for quantity. Students can chalk on the board the number of questions you came up with in thirty seconds. The whole class can repeat back to you all the questions they can remember.

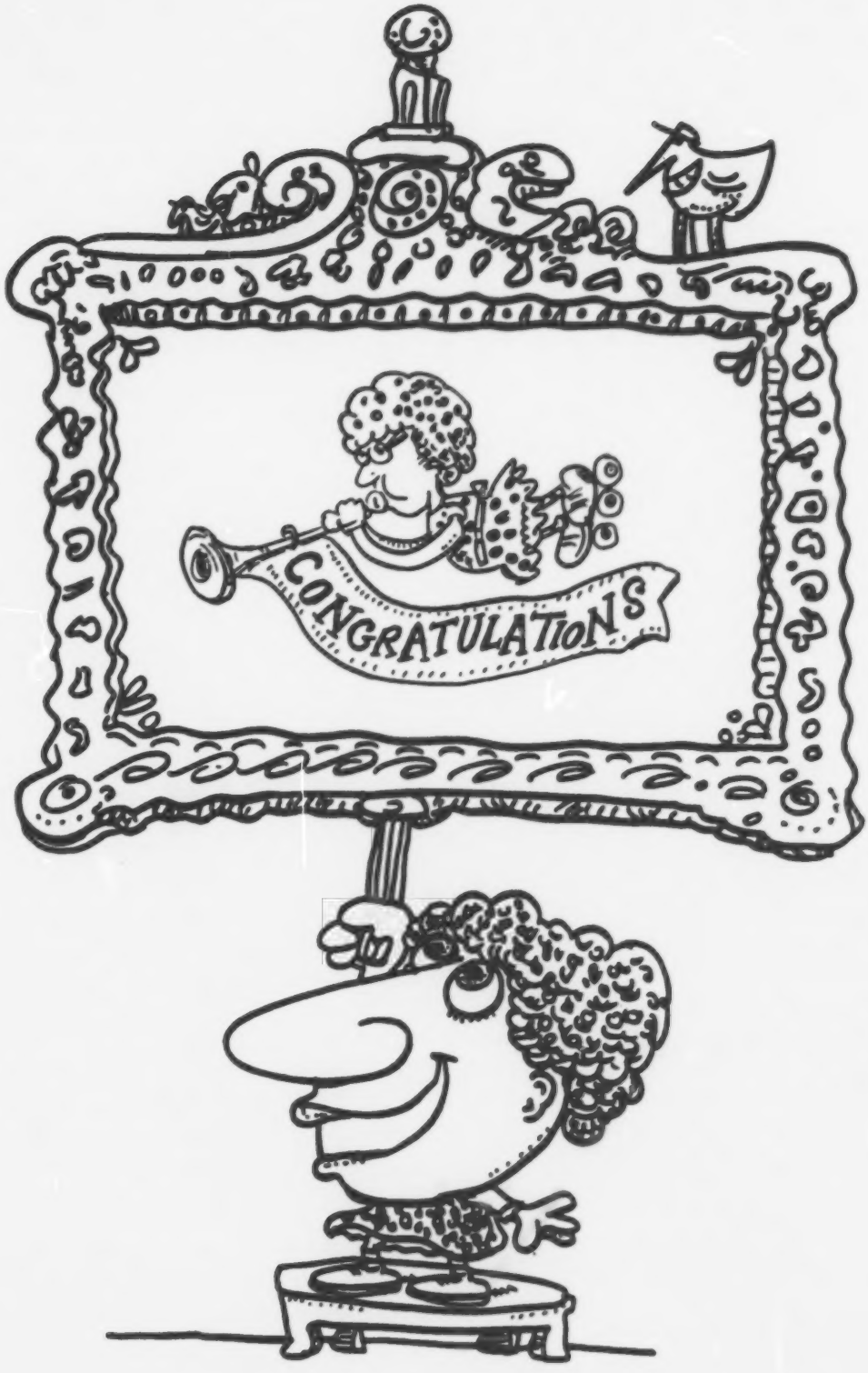
Now, have the students look at their own first picture and in thirty seconds (silently or in a whisper) come up with as many questions as they can. For example, if a student has a picture of a princess in a garden the questions might be: "What is her full name?" "Does she own a dog?" "Is she hoping her mother will buy her classical piano lessons?"...and so on. The students make little chit marks at the bottom of the picture for each question they create. Have them shoot for at least ten questions...more if they can. Then have them pick their favorite question and write it on the BACK of the next empty square. The question might be: "Where does the princess go for pizza after the palace

party?" The students now must DRAW the answer in the open square on the front. They can fill in the picture with lots of detail and background. Then, they ask this picture all the questions they can dream up in a short time...count them with little marks at the bottom of the picture and select a favorite question...write it on the back of the next empty square...draw the answer to it...and repeat the process on their own till all the squares are filled in.

At the end they can share all the pictures and questions. They can partner up and talk the whole thing through or have their partner guess their questions, generate more questions, and so on. You can make a list of question "types" on the blackboard: Who, What, When, Where, Why, How...etc. You can list other categories as well: Transportation, Food, Sports...etc. You can have all the questions relate to what you are studying currently in social studies, science, or English. Pictures create details, details questions. Students realize their own power to generate answers-questions-answers.



STUDENTS ASK QUESTIONS ABOUT THEIR PICTURES (NOTE MARKS AT BOTTOM FOR NUMBER OF QUESTIONS ASKED.)— THEY PICK THEIR FAVORITE QUESTION... AND DRAW AN ANSWER TO IT IN THE NEXT SQUARE... THEY REPEAT THIS UNTIL THEY HAVE FILLED ALL THE SQUARES.


CONGRATULATIONS

Evaluating Through Invention and Inventive Thinking

Michele Munson

Michele Munson

Michele Munson is Executive Director and founder of the Connecticut Invention Convention(CIC). She has been involved with inventing for thirteen years. Since 1983 the C. I. C. has provided the forum for over 30,000 students to become young inventors. Ms. Munson, the recipient of the 1987 Annual Gifted Children's Achievement Award (Connecticut and Western Massachusetts Mensa), has presented nationally and internationally on inventive thinking, creativity and gifted children. She is a member of the National Inventive Thinking Association's (NITA) Advisory Board, Project XL of U.S. Patent and Trademark Office and the Commissioner's Roundtable. An educator for over 25 years, she currently works for the New Hampshire Department of Education Effective Practices Bureau.

Ms. Munson's work with teachers and students on inventing has led to the need to devise activities that go beyond basic instruction. In this section she guides the reader through a variety of activities that incorporate numerous higher-order thinking skills using inventing.

Evaluating Through Invention and Inventive Thinking

Michele Munson

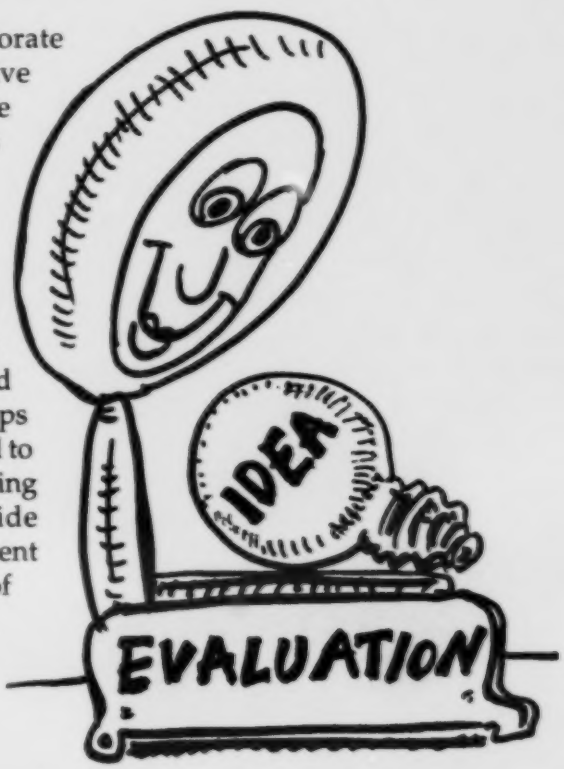
"The judge's results are...9.4, 8.7, 9.6...". Judging is not the only component of evaluating. Evaluation may also include:

- analyzing, refining, and developing
- ranking or prioritizing
- guiding judgment
- selecting or making decisions to guide actions
- defining and clarifying criteria

Evaluating might be intended to:

- make existing things better or more useful
- make new products that do things differently

This section offers examples and ways to incorporate evaluation into activities. It also seeks to give rationale for doing so. Invention and inventive thinking provide the vehicle to make connections across content areas.



Activities related to inventing or inventive thinking incorporate many skills. Seeking necessary information by collecting, organizing and analyzing details is essential. Exploring alternatives, experimenting with materials, and selecting appropriate resources are important steps in the inventing process. Students are encouraged to engage in designing, drawing, modeling, and creating prototypes. The following activities provide opportunities for students to develop and implement plans while focusing on the many methods of evaluation. Using skills such as decision making and problem solving necessitates a shift toward higher order thinking.

Current educational researchers have demonstrated the need for student activities to center on problems, challenges or opportunities that are real for the child. Few involved in education would disagree that learning needs to be interesting, relevant and substantive. Involving students in seeking information from original, local or remote resources are lifelong skills that can be applied in solving real or realistic problems. Encouraging students to observe their surroundings, ask questions and consider responses constructs meaning and promotes caring and respect. Providing opportunities for students to engage in discussion, communicate/share information and ideas, evaluate choices, identify risks and consequences produces responsible citizens.

"Real " activities are more than the "realistic" experiences and activities that are often presented to children. The following chart points out the basic differences and the following student activities seek to illustrate them.

Real	Realistic
Engaging	Plausible
Important to me	Important to someone
Emotional/personal investment	Interesting
Consequences	True to life
Need to act	Stimulating or motivating
Intent and commitment to act	Presented to me
Really carry out the solution	Simulate

Source: Treffinger, D.J. (1994) The Real Problem Solving Handbook. Sarasota, FL: Center for Creative Learning.

An activity that develops a variety of thinking skills examines products and the processes involved in creating them. Before companies produce a new product they conduct market research to test the need for the product, determine how well a product really works, and examine the cost effectiveness and efficiency of creating the product. When students analyze if the product really solves the problem for which it was designed they use "hands on" research using scientific concepts.

Product Analysis Activities

To conduct a product performance test, students need to select a common item that already exists, i.e. paper towels, glue, popcorn, etc., to determine if different brands work similarly to solve the problem and evaluate which product may work the best. The following activity establishes a sound base for the analysis of products.

Background or Parameter Setting

- Generate a list of questions about what the product is supposed to do.
- Discuss possible ways to tell if the product performs as expected.
- Discuss the concept of criterion (the measure used to compare the concerns or questions about an object, i.e., efficiency? cost? time needed ? etc.).

- Define the criteria that will be used by deciding the questions that fit your purposes or need.
- List possible ways that the answers can then be determined.
- Analyze if the information needed will be available or obtainable.
- State criteria with questions like Does it...? or Will it?
- Is there a general list of criteria that could be used for many products?

The following chart for establishing criteria allows students to see that criteria changes depending on the point of view of the person asked. Direct students to create their own list of "stakeholders", criteria and indicators after they have reviewed the information on the What's a "Good/Better" Mousetrap? chart. This chart was shared by Don Treffinger.

WHAT'S A "GOOD"/ "BETTER" MOUSETRAP?

"Stakeholder" Who wants to know?	"Criteria" What are their questions or concerns?	"Indicators" How will they tell? What test(s) information will be needed to show this?
Homeowner	Does it kill the mouse? How does it attract the mouse? Is is easy to use? Is it convenient? Is is durable?	
Squeamish Homeowner	Does it kill the mouse? Do I have to touch it? Do I have to see it? Can I throw it away each time?	
Animal Rights Activist	Does it avoid unnessary suffering? Will it need to kill the animal?	

The product developer would select the target group for the product and include those characteristics that would have greatest appeal for that group. Students who wanted to analyze if a product met the criteria of a certain group would devise ways to test the listed indicators.

TACO SHELL DILEMMA

A student from one of our invention programs wanted a taco shell that didn't crack and leak all over him. So he needed to devise a way to test taco shells. Taco shells need to hold many ingredients, to bend, be crunchy and taste good. His first step was to test existing taco shells.

There are different tests that could be done. It is important to look for problems which might occur as these are set up. What could be done to make sure that the person doing the test didn't select a particular shell because of a brand name or existing advertising claims?

Setting Up a Classroom Product Test -Analyzing Invention or Products
(Adapted from Consumer Reports Product Testing Activities, Prentice Hall)

- Discuss and agree on guidelines for all testers (How much filling will be used? How far should it be opened? Taste test parameters? etc.).
- Have different groups test for the same thing.
- Decide upon a common scoring system for results, i.e. number lines to help convert data to numerical scores, weighting scores, judging criteria.
- Create small cooperative groups to conduct the tests.
- Assign one student the responsibility for writing down the specific questions raised during the process.
- Provide opportunity for testers to discuss their observations and testing questions.
- Discuss data collection techniques, observations, hypotheses and testing conclusions.
- Analyze data interpretation, processes and problems.
- Discuss how data use can develop conclusions. Why did some groups doing the same test get different results?

Number line scoring system: To convert data to numerical scores you should have the variable you are testing as measured against a specific value. A variety of taco shells can be opened only 0.5", another can be opened 3". Use a scale of 1 to 5 with 1 going from 0 to 0.5" and 2 going from 0.5" to 1" and 3 going from 1" to 1.5", etc.

Weighting scores: Some data from tests might be more important than other data. Have students decide which tests were more important and give those tests an importance factor. Multiply scores from those tests by the weighted factor.

Taco Shell Tests Worksheet
This test seeks to answer the questions: 1. 2. 3. 4.
Group members? Recorder?
Materials? (Remember to conceal brand names of taco shells.) 1. 2. 3. 4.
Criteria to be evaluated? 1. 2. 3. 4.
Procedures for measuring, order, data collection? 1. 2. 3. 4.
Scoring?
Results?
Conclusions?
Best Taco Shell?

Extension: Perhaps after conducting these tests students decide that all existing taco shells are inferior. What were the areas that needed improvement? What innovations could be made to the existing shells? In what ways could students create a new and improved taco shell?

EVALUATING THROUGH ERGONOMICS

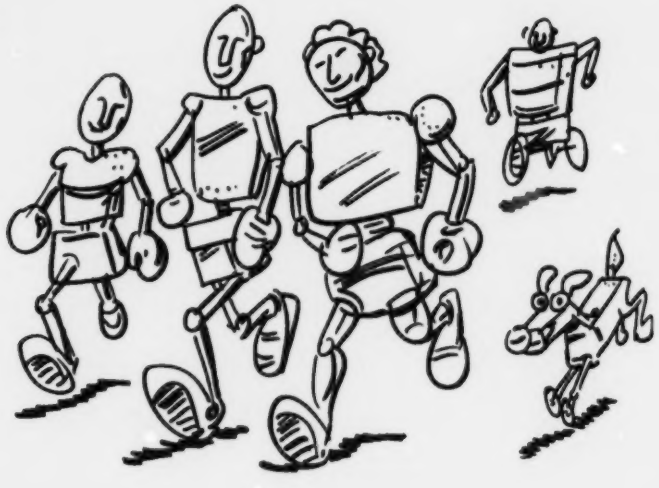
(Adapted from Dr. Michael Doyle, Project UPDATE, Trenton State College, Trenton, N.J.)

Ergonomics is the study of the match between the human body and the environment. Ergonomic design is an attempt to design consumer goods, industrial processes and architectural space so that there is a minimum of stress to the human body.

The human environment is always changing as individuals and society change. There may also be a change in the physical resources or knowledge that are available to bring to bear on a problem. Adults and children frequently face inconvenience in dealing with size, shape or other design features. This inhibits or restricts their comfort or success in achieving the task.

Ergonomics apply in the design of objects for disabled people or in making improvements for limitations of older people. Originally, the conventional QWERTY typewriter keyboard was designed so that the typist could not type faster than the machine could respond. With modern computer keyboards, response time is no longer a concern. An alternate format, designed by August Dvorak in 1932, replaces traditional "home keys" with AOEU/HTNS which increases typing speed by up to 35%. The more frequently used keys are placed on the home row and near stronger fingers. This design also makes the typewriter keyboard more ergonomic. Apple computers used this keyboard design briefly, but unfortunately the traditional arrangement was too firmly entrenched to be displaced, even by superior design.

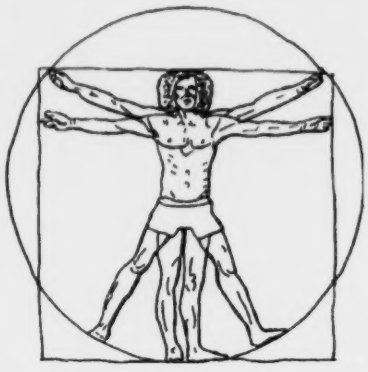
Observation of ergonomic mismatch within the environment can lead students to identify products or systems that do not properly fit the users or the intended use. In the process of determining needed heights or sizes for varied populations, children will become involved with many aspects of measurement and analysis. While ergonomics is the study of how the human body relates to the environment, anthropometrics is the study of design based on the dimensions of the body. Anthropometrics is the reading of measurement of the human body in terms of height, width, weight, reach, grip, angle of vision, etc.



ANTHROPROMETRICS ACTIVITY

(Adapted from Dr. Michael Doyle, Project UPDATE, Trenton State College, Trenton, N.J.)

Humans have long been interested in the relationship of the human body to the environment. Leonardo da Vinci created a drawing he called "Vitruvian Man" that demonstrated the proportions of the human body. If a person lies down with their arms and legs outstretched, a circle can be drawn around their fingertips and feet. Have students test this out. They will notice that there is no real "average" person.



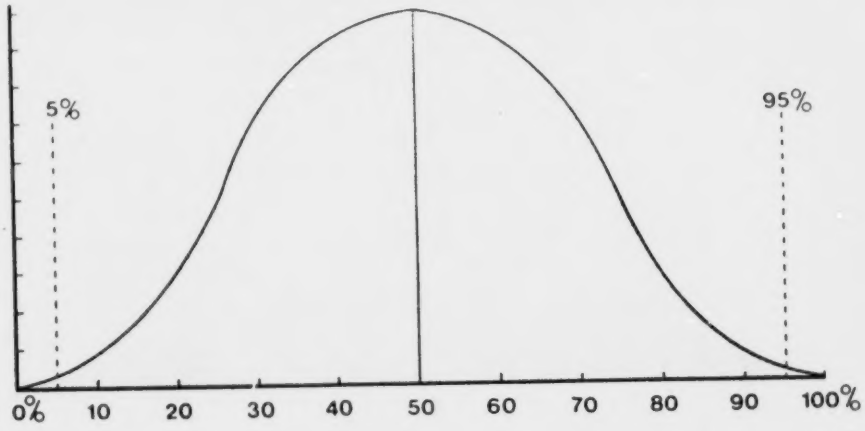
However, scientists and designers have found that most of the population fits a bell curve type distribution and they aim to make most design environment fit the middle.

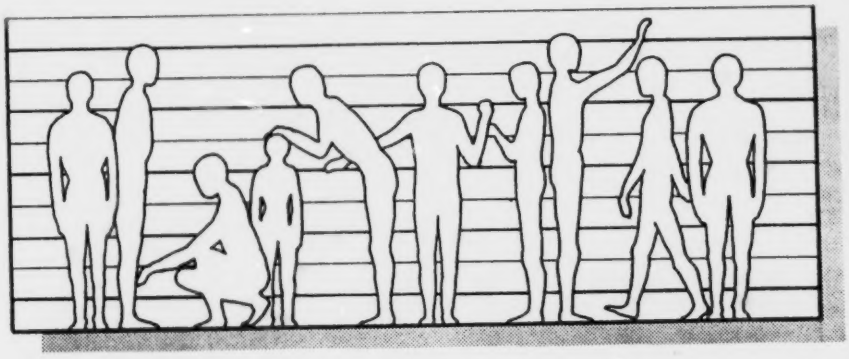
There is no such creature as an average human being.

Every person is an individual. Every person is different in terms of body size.

How does a designer allow for this when designing for people?

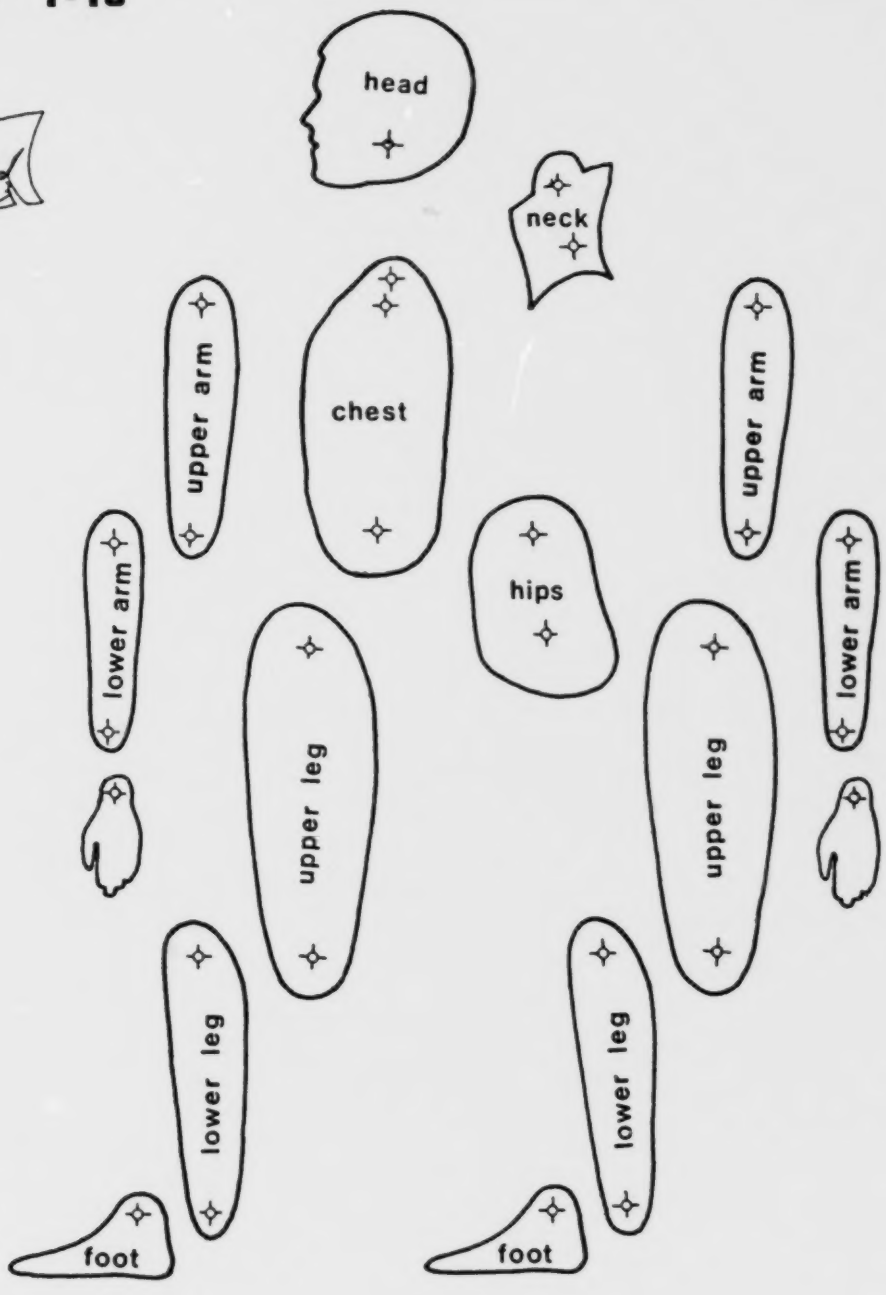
The graph on the right shows a distribution curve for a given number of people in relation to height.
The graph shows that some people are very tall, some are very small but the **majority** fall into the category either side of the middle line or 'mean'.
The designer tries to design for as many people as possible but there are a few at either end of the scale who may not be catered for. The aim is to design for at least 90% of the total number of people. This means that 5% at either end of the scale are not taken into consideration. These limits are known as the **5th and 95th percentile.**





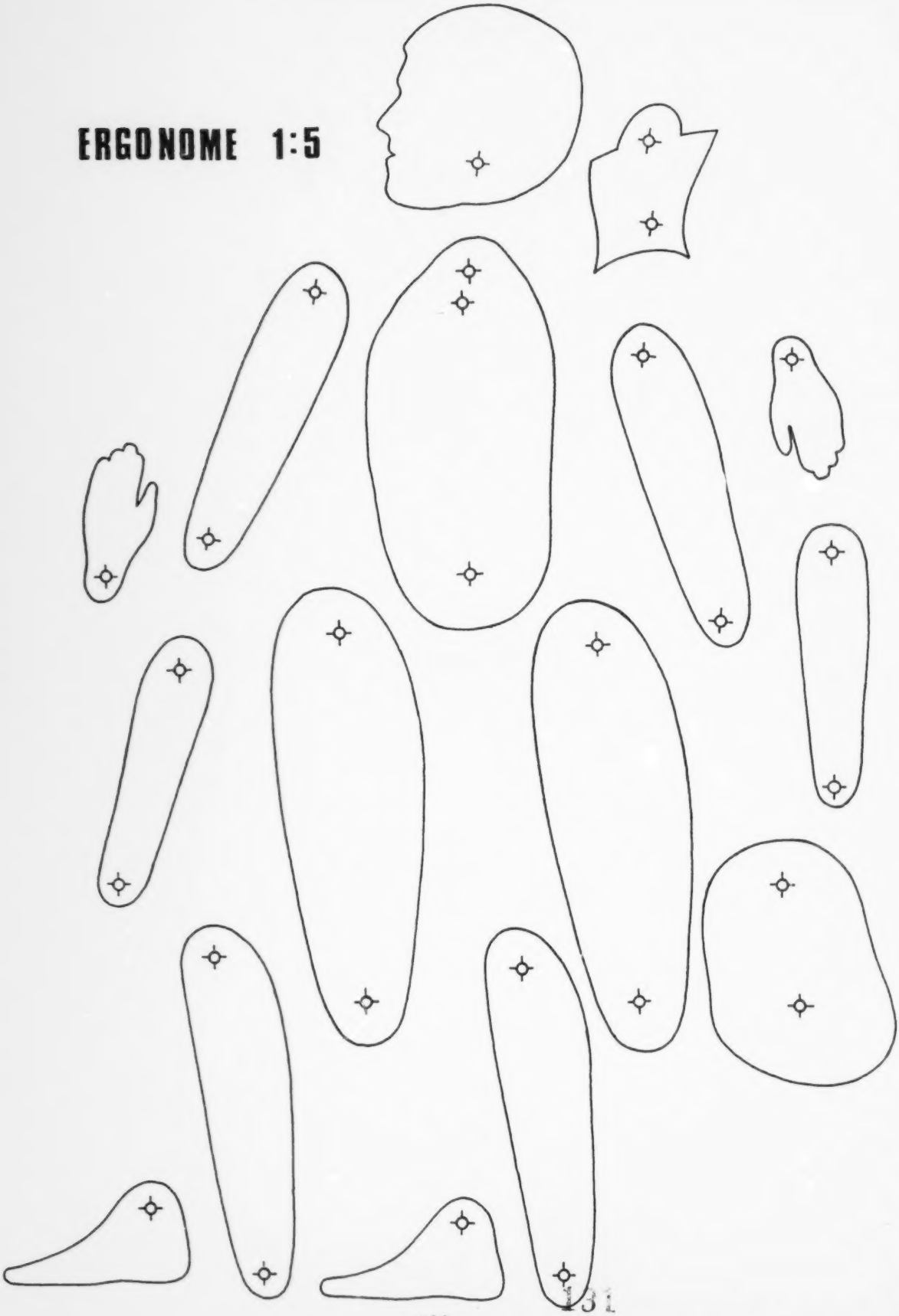
The following two pages have an average figure with anthropometric dimensions that designers use. Have students cut out and mount the shapes on stiff cardboard or plastic to make an "Ergo-nome." One figure is drawn to a 1:10 scale which is 1/10 the size of a human and the other is 1:5 scale. The figure should be joined at the pivot points shown to make a movable figure. (Note: There are two pivot points at the top of the chest. The upper is the pivot point for the neck, and the lower is the pivot point for the arm.) Then ask students to make a drawing or a three dimensional environment for their "Ergo-nome."

ERGONOME 1:10



Cut out and paste the shapes shown above on to stiff card or thin plastic to make an 'Ergo-nome'.
The figure is drawn to a scale 1:10.
The figure should be joined at the pivot points shown to make a moveable figure to be used in design situations for the human body.
NOTE. There are two pivot points at the top of the chest. The upper of the two is the pivot point for the neck, and the lower point is the pivot point for the upper arm.

ERGONOME 1:5

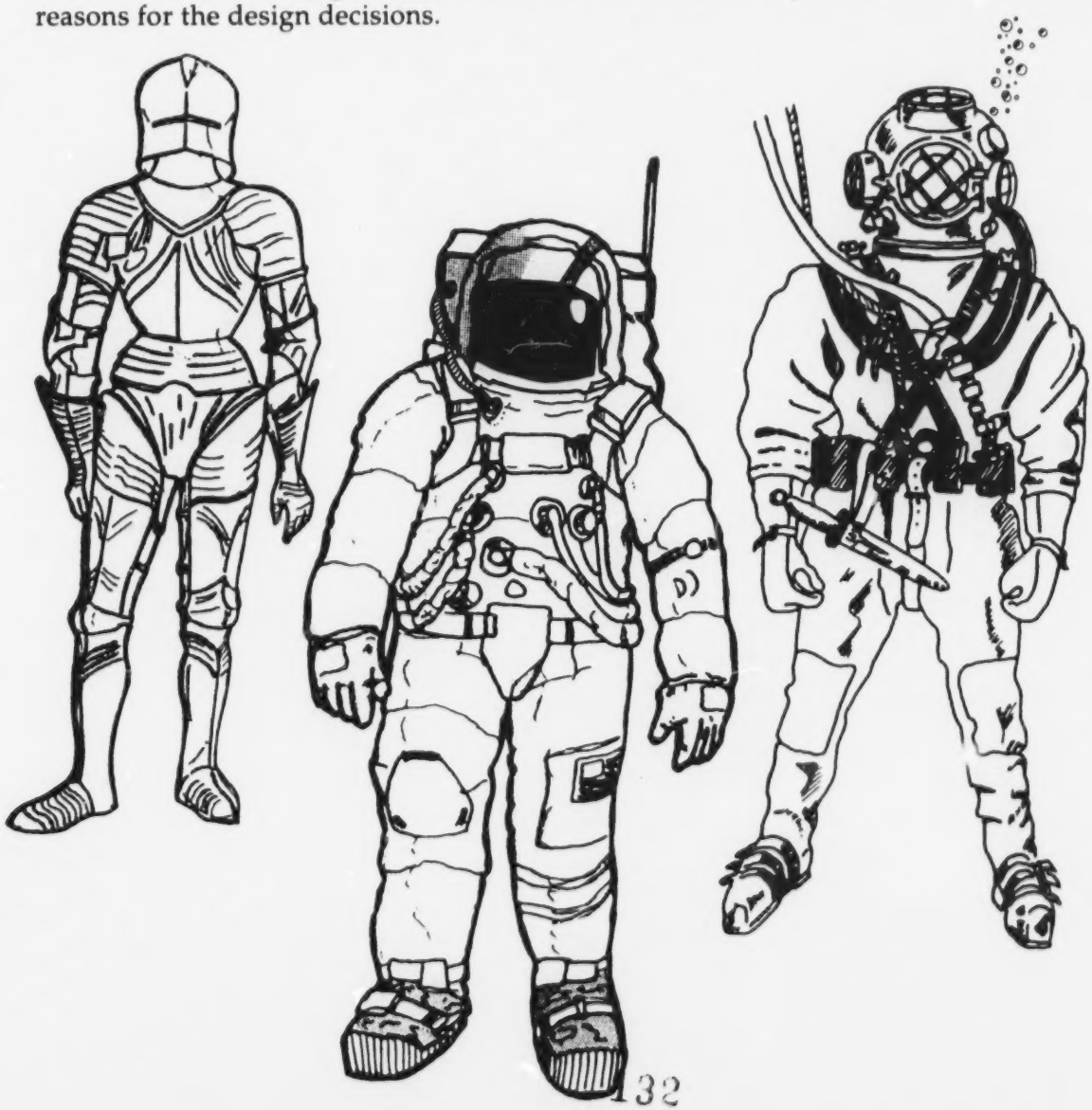


ANALYZING "SUIT" DESIGN

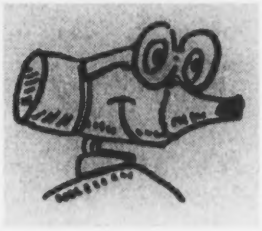
Humans have always worked to improve the quality of life and to be comfortable in many situations. The three figures below are from different periods of history and are wearing quite different outfits. Ask students to:

- study each figure
- describe the environment in which it was used
- describe and discuss the design choices made
- observe and note materials used - give reasons why they were chosen

Have the students bring in other suits and make more comparisons and discuss the reasons for the design decisions.



Looking at existing inventions can lead to an improvement of an object, an innovation or to a whole new invention. It can also develop into an understanding of previous uses or potential adaptations for future use. This activity can be an idea starter for an invention unit. It can also work well to initiate a discussion of furniture design or household items or any every day object.



Use PLTS #1 with this activity to introduce the concept of product rating.

ERGONOMIC RATING ACTIVITY

Obtain three to five different types of chairs (coat hangers, irons, student supplies, etc. also work well) from around school or home. These should represent different periods, uses and needs, i.e. high chair, wheelchair, student desk chair, drafting chair, bench, etc.

Ask students to observe differences among the chairs (use, material, size, etc.) Consider the historical background of the object. As they make observations have them question changes in the composition, appearance, efficiency, etc.

Students should discuss the principles that may have governed the chair's design and it's intended use. Look for where it is generally used and conversely where it cannot be used. Are there any factors which have specific bearing on its use or inability to be used?

Students can use the Ergonomic Rating Chart to rate the overall usefulness of each item. The Problem Area section of the chart can be used to identify potential innovation or invention ideas. In this way, as students highlight design flaws, solutions can be generated to create new products.

ERGONOMIC RATING CHART

Rate items on a scale from 1 (poor) to 5 (excellent)

Name of Invention	Durability Rating (How long will it last?	Safety Rating (Can it be used without harm?)	Stress Rating (Does it need little or no instruction? Is it comfortable to use?)	Problem Areas

The result of investigation leads the student to focus on a possible solution that is more ergonomic. If the student sees these problems as real, they become committed to developing solutions and feel a sense of ownership of the problem. This gives purpose and focus to their actions.

Their attempts to create are more likely to be effective. The use of thematic areas helps students find more information and offers more possible alternatives. The following activity uses a known environment such as school, community, business or industry, that leads to real problem solving.

Ergonomic Solutions - Have students select a theme such as classroom layout or design, playgrounds, future schools, book bags, adaptive devices for the disabled, exercise devices, etc. The following questions encourage further investigation and analysis and gives students the opportunity to produce numerous responses. This should be a brainstorming session with all responses accepted, no critiquing permitted and hitchhiking allowed.

Sample Thematic Area — Book Bags

Guiding questions for brainstorming:

- What do you like about book bags?
- What are some things you don't like about them?
- What could be used instead of a book bag?
- Who uses them?
- Is it easy to transport? Use?
- Are there any safety issues?

THE ADVANTAGES, LIMITATIONS AND UNIQUE FEATURES CHART

Advantages	Limitations	Unique Features

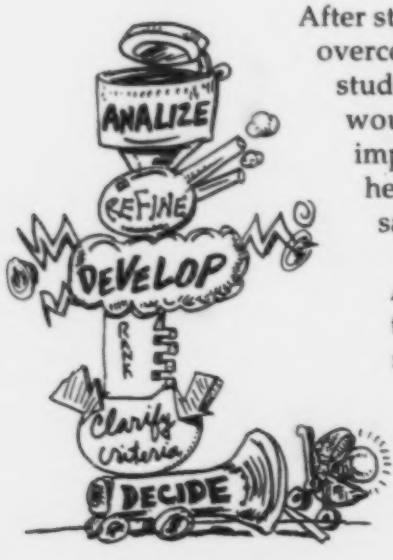
[Source: Isaksen, S.G., Dorval, K.B., & Treffinger, D.J. Creative Approaches to Problem Solving. (1944) Dubuque, IA: Kendall-Hunt Publishers]

This chart will help focus and organize student ideas

1. Start with A! A = Advantages. What's good about it?

2. L = Limitations. Pose these in the form of "How to ...." or "How might ... " questions, not "We can't because ... " or "What's wrong ... "

3. U = Unique Features. What is different about this? What makes it stand out? How is it original?



After students complete the A/L/U chart they can find ways to overcome any of the ergonomic limitations indicated. If the students design or construct a new or improved product, it would be necessary to evaluate it to determine if the improvements are essential. The following activity could help to guide those evaluations. Students could use the same object in small groups and compare their results.

Accumulating attributes can help evaluate whether or not the new product is improved or not. To determine significant differences, list all other existing products that also serve the same purpose as the proposed innovation. Use the chart on the next page to evaluate each item. If the totals are not significantly different, design changes need to be considered.

INNOVATIONS CRITERIA CHART: Accumulating Attributes

Overall Invention(s) Rating	Criteria	Proposed Innovations Rating
	Durability	
	Cost Effectiveness	
	Possibility of Multiple Use	
	Easy to Use	
	Comfort Rating	
	Easy to Maintain	
	Safety Factors	
	Efficient	
	Humor/Attractive Appearance	
	Other...	
Total =		Total =

Rating Scale: 4 = The product meets the criterion in any way you can think of.

3 = The product generally meets the criterion. There are some ways that it is only okay.

2 = The product sort of meets the criterion.

1 = The product does not meet the criterion at all.

USING DATA IN INVENTING

The following activity is adapted from B. Edward Schlesinger Jr.'s, *How to Invent* (IFI Plenum Data Corp, 1987, NY). He suggests that analyzing the data about an object, invention or situation will lead to information for inventing. Data can be gathered by asking questions that take the object's composition, appearance and weight into account.

Understanding why something exists by exploring the historical background also brings an awareness of the principles involved in its creation. This can lead to anticipation of possible improvements in it or in the processes that react with it. Using the five senses (sight, smell, touch, taste and sound) may also lead to an improvement.

The following Data Chart may lead to numerous invention ideas.

Have students answer the questions about the object with as much detail as possible. Specific responses provide more information for analysis. Analysis leads to greater understanding of the object's characteristics that can be changed to produce new and better results.

Data Chart

	Compostition A listing of all materials/parts.	**Advantages** What is good about the way it currently exists?	**Disadvantages** What are limitations to it now?	**Changes to Produce a New and Better Result** (Consider how it applies to the 5 senses too.)
Appearance size, shape, color				
Weight density				
When is it Used period of time - past, present, future				
Where is it Used place, climate environment				
How is it Used position, movements				
Who will be the User age, height needed, physical features				

Through these activities, students have analyzed, refined, developed, ranked, clarified criteria and made decisions. Students have engaged in real life activities and have used many skills. Content areas included math, history, science and literature. The results of these activities have improved existing objects and have led to the development of new products or methods. The skills demonstrated are evaluative, the products are real, the thinking is evident.

From the Mouths of...

Jan Casner

Jan Casner

Jan Casner serves on the Board of Directors of the National Inventive Thinking Association. She is currently an elementary school principal and has enjoyed roles as Camp Invention Director, teacher in the gifted program and instructional specialist. Jan has also worked on a national thinking skills project as Project XL Coordinator for the U.S. Patent and Trademark Office while on loan from her school district. Her interest and experiences in Inventive Thinking have resulted in production of curriculum, and videos and workshop presentations throughout the country. Of most importance, however, is her actual experience in helping children experience their own inventiveness. The use of selected quotations has played an integral part in her activities for both children and adults. Hopefully this section about quotations will provide additional resources to inspire you and your students.

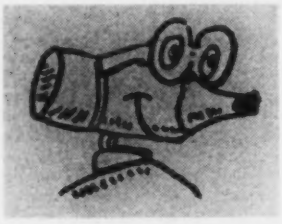
FROM THE MOUTHS OF...

Jan Casner

The wisdom of a lifetime is often found succinctly, eloquently, or humorously expressed by the sages in quotations —renowned or obscure. These *pearls* move us, inspire us, and touch our hearts, minds, and souls.

How often have you been amazed by the wisdom or wit spilling from the "mouths of babes"? Fresh pearls, not formed through years of chafing against life's gritty challenges, magically emerge from the innocence and insight of experiencing this world anew. If we had captured these pearls, we could all have written volumes. Perhaps this chapter will help seed more pearls, linguistic or otherwise.

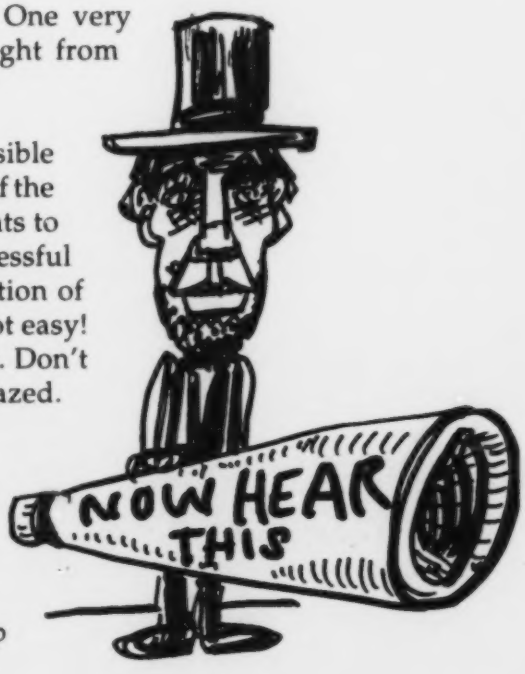
Intrigued by the well turned, pithy phrase, I have long collected notable quotes. The loosely categorized quotations in this chapter have been selected for their value as both definition and inspiration for Inventive Thinking. Categories are sequenced following the steps of the inventive process. The great diversity of sources illustrates the universality of the creative and inventive threads that have always enriched the tapestry of mankind.



Use PLTS #4 with this activity. Good quotes use metaphors and analogies.

What are some ways to use these quotations? One very POWERFUL strategy has elicited profound thought from students.

Each week have class discussions about the possible meanings or various interpretations of the "quote of the week." After several weeks, CHALLENGE students to write something worth quoting. This is most successful after sufficient exposure to and adequate exploration of the art. Join your students in the challenge. It's not easy! For most it takes time for incubation and refinement. Don't expect instant products, but be prepared to be amazed.



What are other POWERFUL uses?

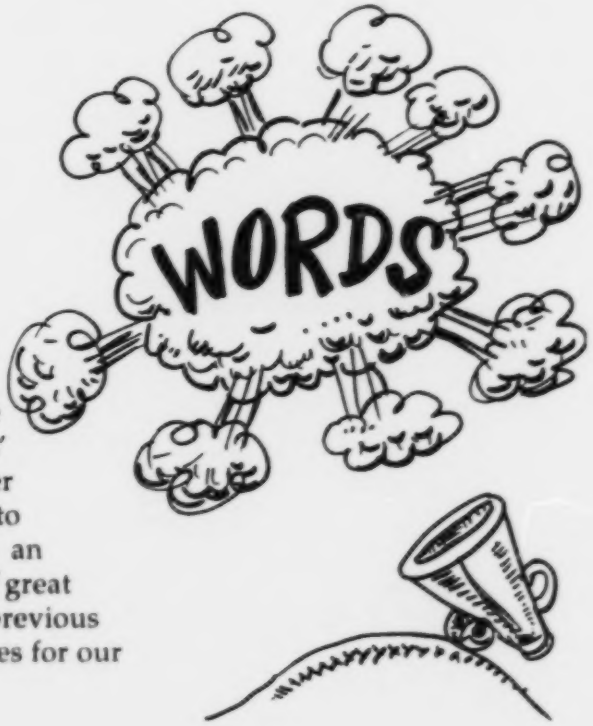
- an encouraging word or note to a student or adult (especially during the inventive thinking process)
- small group discussion - let each group present and defend its interpretation

- lesson or unit introduction
- student comparison of similar quotes to decide which is most powerful, eloquent, effective, . . .
- discussion and/or research of the context of the quote
- paragraph, essay, or story starters - students could choose one from three quotes

- class newsletters from students to parents
- prominently placed posters - student made and illustrated

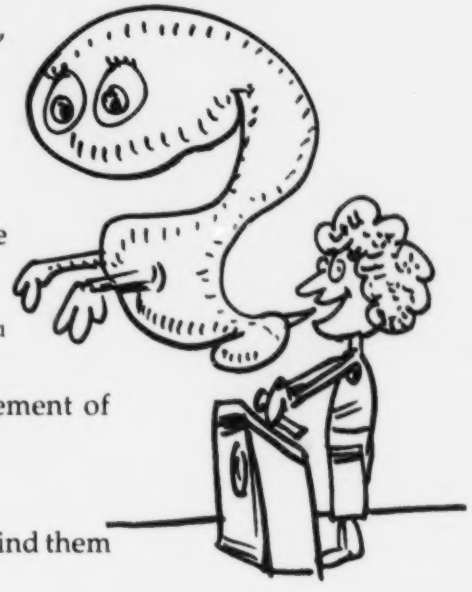
What are the benefits?

- inspiration, motivation, comfort
- thought and discussion about what is essential for progress, education, success
- learning economy of words
- playing with language
- appreciation of wisdom
- having fun
- emphasis for important points



Never underestimate the power of words. Thomas Paine's "These are the times that try men's souls..." was adopted as the watchword for George Washington's troops' movement on Trenton. The Commander had ordered Paine's *The Crisis* to be read to his troops. It is believed to have been an inspiration for their subsequent victory, of great importance for troop morale after their previous retreat across the Delaware. Daily victories for our students sometimes require inspiration.

PURSUE KNOWLEDGE—OBSERVE—INQUIRE



If a child is to keep alive his inborn sense of wonder..., he needs the companionship of at least one adult who can share it, rediscovering with him the joy, excitement and mystery of the world we live in.

—Rachel Carson

In the fields of observation chance favors only those minds which are prepared.

—Louis Pasteur,
A Treasury of the World's Great Speeches [1]

The whole of science is nothing more than a refinement of everyday thinking.

—Albert Einstein

I decided fifty years ago to ask no one for answers, to find them out for myself. I suggest you do the same.

—R. Buckminster Fuller

If he is indeed wise, he does not bid you enter the house of his wisdom, but rather leads you to the threshold of your own mind.

—Kahlil Gibran

One thing I have learned in a long life is that all our science, measured against reality, is primitive and childlike—and yet it is the most precious thing we have.

—Albert Einstein

Perplexity is the beginning of knowledge.

—Kahlil Gibran,
Voice of the Master [1]

The entrepreneur always searches for change, responds to it and exploits it as an opportunity.

—Peter Drucker
Innovation and Entrepreneurship, 1985

Necessity is the mother of invention.

—Roman saying

In the end, we will conserve only what we love; we will love only what we understand; and we will understand only what we are taught.

—Baba Dioum (Senegal)

A chief event in life is the day in which we have encountered a mind that startled us.
—Ralph Waldo Emerson

Somebody's boring me... I think it's me.
—Dylan Thomas

Tomorrow's illiterate will not be the man who can't read; he will be the man who has not learned how to learn.
—Herbert Gerjudy, psychologist

Life is an adventure, not a guided tour.
—Anonymous

There are two ways to slide easily through life; to believe everything or to doubt everything. Both ways save us from thinking.
—Alfred Korzbski

It is not important what you cover in school....It is important what you uncover.
—Anonymous

To understand is to invent.
—Jean Piaget

If a man empties his purse into his head, no man can take it away from him. An investment in knowledge always pays the best interest.
—Benjamin Franklin

What is a scientist ?. . . We give the name of scientist to the type of man who has felt experiment to be a means guiding him to search out the deep truth of life, to lift a veil from its fascinating secrets, and who, in this pursuit, has felt arising within him a love for the mysteries of nature so passionate as to annihilate the thought of himself.
—Maria Montessori,
The Montessori Method [1]

First and last, what is demanded of genius is love of truth.
—Johann Wolfgang von Goethe,
Wanderer's Nightsong

Personally I am always ready to learn, although I do not always like to be taught.
—Winston Churchill

I am engaged always in a dialogue in Nature. In my experience, in what I perceive in human experience, I see analogies. I see connections with what I have observed and experienced in Nature.
—Jonas Salk

Access to stimulating objects produces a thicker cortex and larger neurons which...facilitate more accurate problem solving, a key component of intelligence.
—Marian Diamond

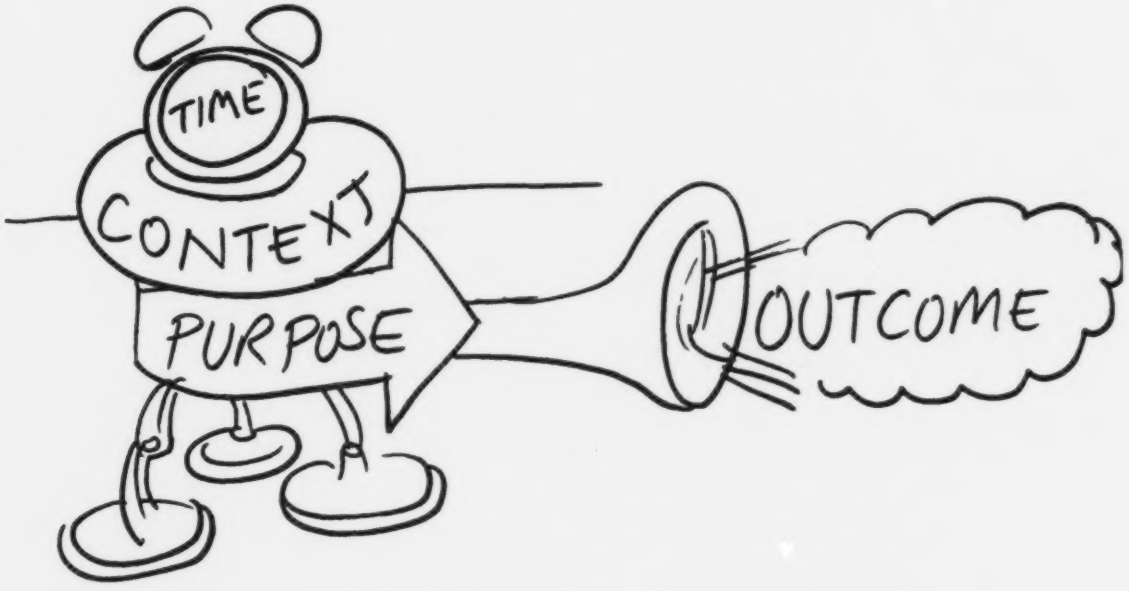
To find an answer is meaningful... but there is also beauty in the search.
—Anonymous

To see the World in a Grain of Sand
And a Heaven in a Wild Flower,
Hold Infinity in the palm of your hand
And Eternity in an hour.
—William Blake, "Auguries of Innocence"

Do not then train youth to learning by force and harshness
But direct them to it by what amuses their minds
So that you may be better able to discover with accuracy
The particular bent of the genius of each.
—Plato

As we acquire more knowledge, things do not become more comprehensible but more mysterious.
—Albert Schweitzer

People are generally better persuaded by the reasons they have themselves discovered than by those which have come into the mind of others.
—Pascal



SEE THE VISION

Perhaps you have heard the story of Christopher Wren, one of the greatest of English architects, who walked one day unrecognized among the men who were at work upon the building of St. Paul's cathedral in London which he had designed. "What are you doing?" he inquired of one of the workmen, and the man replied, "I am cutting a piece of stone." As he went on he put the same question to another man, and the man replied, "I am earning five shillings two pence a day." And to a third man he addressed the same inquiry and the man answered, "I am helping Sir Christopher Wren build a beautiful cathedral."

—Attributed to Louise Bush-Brown, Director of the Pennsylvania School of Horticulture for Women. (Unverified.)[1]

...the painter who turns a yellow spot into the sun rather than one who turns the sun into a yellow spot.

—Pablo Picasso

The world is before you and you need not take it or leave it as it was when you came in.

—James Baldwin

To give a fair chance to potential creativity is a matter of life and death for any society.

—Arnold Toynbee

The greatest privilege is to invent your own future.

—Anonymous

This time, like all times, is a very good one if we but know what to do with it.

—Ralph Waldo Emerson

Ah, but a man's reach should exceed his grasp,
Or what's a heaven for?

—Robert Browning[2]

If man does not know to what port he is sailing, no wind is favorable.

—Socrates

The significance of man is not what he attains, but in what he longs to attain.

—Albert Schweitzer

Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.

—Margaret Mead

A man has made at least a start on discovering the meaning of human life when he plants shade trees under which he knows full well he will never sit.

—Elton Trueblood

That the best picture has not yet been painted; the greatest poem is still unsung; the mightiest novel remains to be written; the divinest music has not been conceived even by Bach. In science, probably ninety-nine percent of the knowable has to be discovered.

—Lincoln Steffens[1]

If you have built castles in the air, your work need not be lost; that is where they should be. Now put the foundations under them.

—Henry David Thoreau, *Walden,* ch. 18, p. 427 (1966). Originally published in 1854[1]

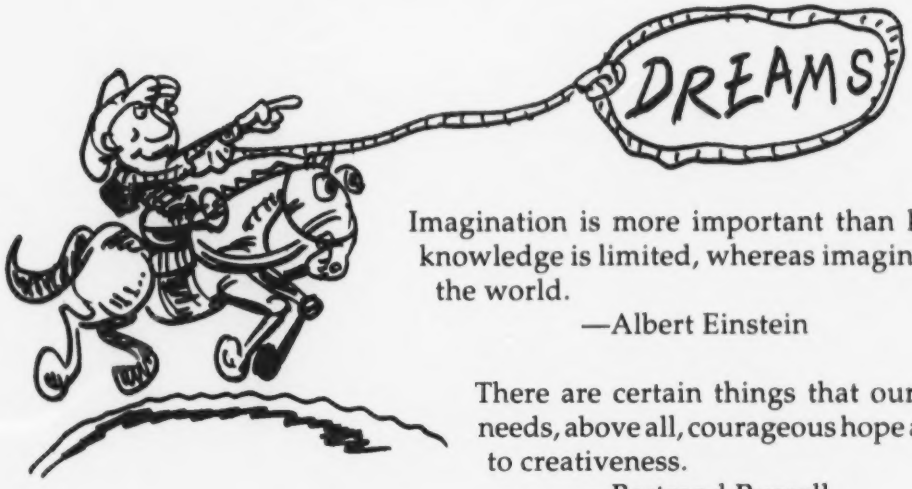
An invasion of armies can be resisted, but not an idea whose time has come.

—Victor Hugo

Most people look at what is; they never see what can be.

—Anonymous

CREATE—IMAGINE—DIVERGE—EXPERIMENT



Imagination is more important than knowledge, for knowledge is limited, whereas imagination embraces the world.

—Albert Einstein

There are certain things that our age needs. It needs, above all, courageous hope and the impulse to creativeness.

—Bertrand Russell

What feeling, knowledge, or will man has depends on the last resort upon what imagination he has.

—Soren Kierkegaard

The most valuable of our natural resources is our own creativity. What we must learn to do is not stifle it, not kill it.

—Dr. Jonas Salk

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There is nothing wrong with chasing dreams...you might catch one.
—Anonymous

Towering genius disdains the beaten path. It seeks regions hitherto unexplored.
—Abraham Lincoln,
Address to The Young Men's Lyceum, 1838

Genius means nothing more than the facility of perceiving in an unhabitual way.
—William James,
The Principals of Psychology

There is always an easy solution to every human problem—neat, plausible, and wrong.
—H.L. Mencken,
A Mencken Chrestomathy, 1949[1]

When patterns are broken, new worlds can emerge.
—Tuli Kupferberg

A stumble may prevent a fall.
—English Proverb

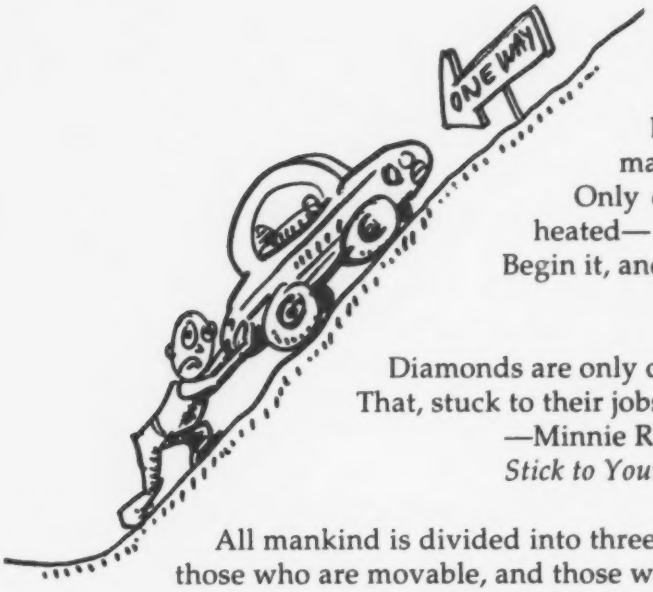
When you can do the common things in life in an uncommon way, you will command the attention of the world.
—George Washington Carver

A great man is he who has not lost the heart of a child.
—Mencius

Creativity is contagious. Pass it on!
—Anonymous

The compulsion to take ourselves seriously is in inverse proportion to our creative capacity. When the creative flow dries up, all we have left is our importance.
—Eric Hoffer,
Thoughts of Eric Hoffer, Including: 'Absolute Faith Corrupts Absolutely,' [1]

BEGIN—COMMIT—WORK—PERSERVERE



Are you in earnest? Seize this very minute—
What you can do, or dream you can, begin it.
Boldness has genius, power, and magic in it.
Only engage, and then the mind grows heated—
Begin it, and the work is completed!
—Goethe

Diamonds are only chunks of coal,
That, stuck to their jobs, you see.
—Minnie Richard Smith,
Stick to Your Job [1]

All mankind is divided into three classes: those who are immovable, those who are movable, and those who MOVE.
—Ben Franklin

Without discipline, there's no life at all.
—Katherine Hepburn

Nothing in the World can take the place of persistence. Talent will not; nothing is more common than unsuccessful men with talent. Genius will not; unrewarded genius is almost a proverb. Education will not; the world is full of educated derelicts. Persistence and determination are omnipotent. The slogan "press on" has solved and always will solve the problems of the human race.
—Attributed to Calvin Coolidge. Unverified, though this appeared on the cover of the program of a memorial service for him in 1933.[1]

When the world seems large and complex, we need to remember that great world ideals all begin in some home neighborhood.
—Konrad Adenaur

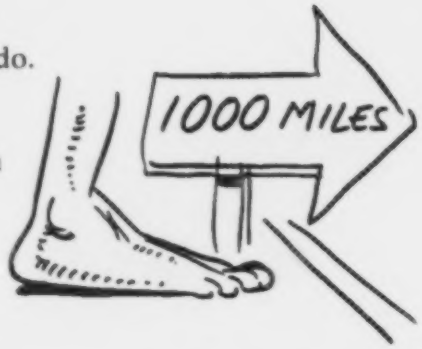
Genius is one percent inspiration and ninety-nine percent perspiration.
—Thomas Alva Edison, *Life*

If you choose to work you will succeed; if you don't, you will fail.
—Sidney Smith

Never give in, never give in, *never, never, never, never* - in nothing, great or small, large or petty— never give in except to convictions of honour and good sense.
—Winston Churchill, speech at Harrow School, Harrow, England, October 29, 1941.[1]

Genius is nothing but a greater aptitude for patience.
—de Buffon

None of the secrets of success will work unless you do.
—Fortune Cookie



A journey of a thousand miles must begin with a single step.
—Chinese Proverb

The secret of success is constancy of purpose.
—Benjamin Disraeli, speech at banquet of National Union of Conservative and Constitutional Associations, Crystal Palace, London, June 24, 1872.[1]

Let me tell you the strength that has led me to my goal. My strength lies solely in my tenacity.
—Louis Pasteur[3]

The will to win is not nearly as important as the will to prepare to win.
—Bobby Knight

The man who removes a mountain begins by carrying away small stones.
—Chinese Proverb

One always has time enough, if one will apply it well.
—Johann Wolfgang Von Goethe,
The Autobiography of Johann Wolfgang Von Goethe.[1]

It is while we are young that the habit of industry is formed. If not then, it never is afterwards. The fortune of our lives, therefore, depends on employing well the short period of youth.
—Thomas Jefferson

Yesterday is a canceled check; tomorrow is a promissory note; today is the only cash you have - so spend it wisely.
—Kay Lyons

Somebody said that it couldn't be done,
But he with a chuckle replied
That "maybe it couldn't" but he would be one
Who wouldn't say so till he'd tried.
So he buckled right in with the trace of a grin
On his face. If he worried he hid it.
He started to sing as he tackled the thing
That couldn't be done, and he did it.
—Edgar A. Guest, "It Couldn't be Done," stanza 1,
Collected Verse of Edgar A. Guest. [1]

We cannot direct the wind, but we can adjust our sails.
—Anonymous

Even if you're on the right track, you'll get run over if you just sit there.
—Will Rogers

The mode in which the inevitable comes to pass is through effort.
—Justice Oliver Wendell Holmes, "Ideals and Doubts," *Collected Legal Papers*.[1]

It is part of the American character to consider nothing as desperate; to surmount every difficulty by resolution and contrivance.
—Thomas Jefferson

I walk slowly, but I never walk backward.
—Attributed to Abraham Lincoln, unverified.[1]

Use PLTS #9 with these quotes to help students become aware of and self-assess their "inner voice."

FOLLOW HUNCHES AND INTUITION—RISK

An idea is a feat in association.
—Robert Frost

We must walk consciously only part way toward our goal, and then leap in the dark to our success.
—Author unknown. Attributed to Henry David Thoreau, but not found in his works.[1]

One of the reasons mature people stop learning is that they become less willing to risk failure.
—John Gardner

Nothing would be done at all if a person waited until s/he could do it so well that no one could find fault with it.
—Newman

Talent is a flame. Genius is a fire.
—Bern Williams

MAINTAIN CONFIDENCE AND INDIVIDUALITY

Great spirits have always encountered violent opposition from mediocre minds.
—Albert Einstein

It is much easier to be critical than to be correct.
—Benjamin Disraeli, speech, Jan. 24, 1860

One person with courage makes a majority.
—Attributed to Andrew Jackson

If a man does not keep pace with his companions, perhaps it is because he hears a different drummer. Let him step to the music which he hears, however measured or far away.
—Henry David Thoreau, *Walden* [3]

A person who never made a mistake never tried anything new.
—Anonymous

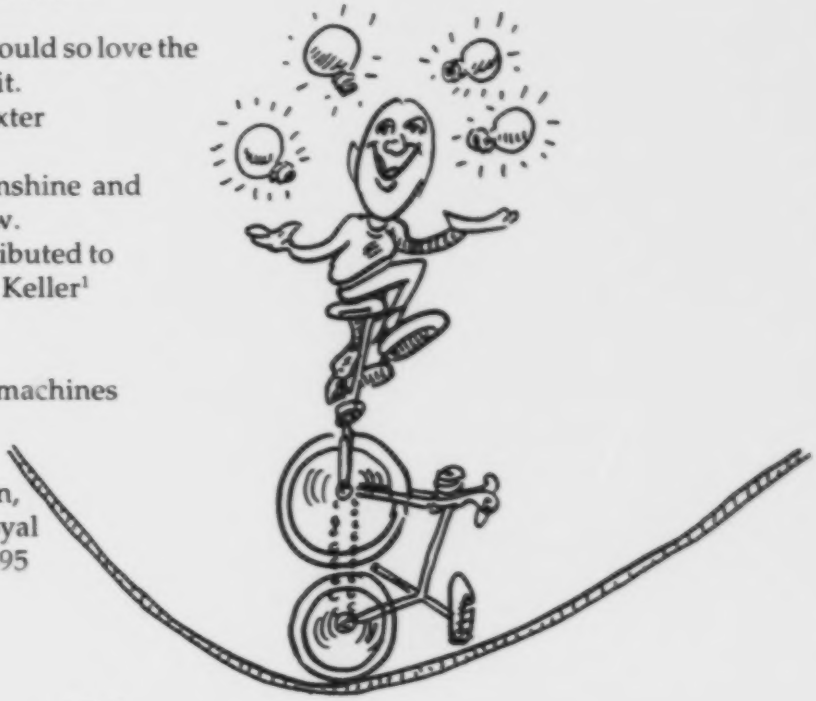
I am not judged by the number of times I fail, but by the number of times I succeeded, and the number of times I succeed is in direct proportion to the number of times I can fail, and keep trying.
—Tom Hopkins

A man of genius makes no mistakes. His errors are volitional and are the portals of discovery.
—James Joyce

It is curious that the leaf should so love the light and the root so hate it.
—Thaxter

Keep your face to the sunshine and you cannot see the shadow.
—Attributed to Helen Keller[1]

Heavier than air flying machines are impossible.
—Lord Kelvin, President, Royal Society, c. 1895



It is not the critic who counts; not the man who points out how the strong man stumbles, or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood; who strives valiently; who errs, and comes short again and again, because there is no effort without error and shortcoming; but who does actually strive to do the deeds; who knows the great enthusiasms, the great devotions; who spends himself in a worthy cause; who at the best knows in the end the triumph of high achievement, and who at the worst, if he fails, at least fails while daring greatly, so that his place shall never be with those cold and timid souls who know neither victory nor defeat.

—Theodore Roosevelt, *The Strenuous Life* [1]

Well informed people know it is impossible to transmit the voice over wires, and that, were it possible to do so, the thing would be of no practical value.

—Boston Post editorial, 1865

A man's life is interesting primarily when he has failed —I well know. For it's a sign that he tried to surpass himself.

—Georges Clemenceau, *Clemenceau, The Events of His Life* as Told by Himself to His Former Secretary, Jean Martet[1]

Things which matter most must never be at the mercy of things which matter least.

—Goethe

It is hard to fail, but it is worse never to have tried to succeed.

—Theodore Roosevelt, *The Strenuous Life* [1]

There are no secrets to success. It is the result of preparation, hard work, learning from failure.

—Gen. Colin L. Powell,
The Black Collegian

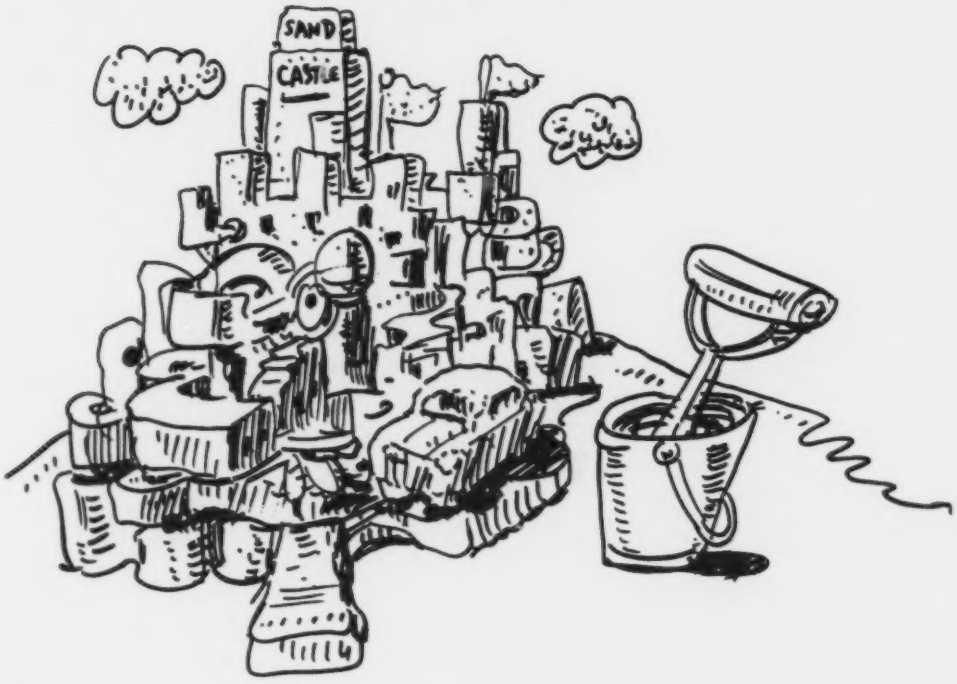
The only limit to our realization of tomorrow will be our doubts of today. Let us move forward with strong and active faith.

—Franklin D. Roosevelt, *The Public Papers and Addresses of Franklin D. Roosevelt* [1]

Don't major in minor things.

—Anonymous

CREATE QUALITY



Quality is never an accident. It is always the result of intelligent effort. It is the will to produce a superior thing.

—John Ruskin

No brain is stronger than its weakest think.

—Thomas L. Masson, *Laughs* [1]

I do the very best I know how — the very best I can; and I mean to keep doing so until the end. If the end brings me out all right, what is said against me won't amount to anything. If the end brings me out wrong, ten angels swearing I was right would make no difference.

—Abraham Lincoln. - Francis Carpenter,
Six Months at the White House [1]

Ability will never catch up with the demand for it.

—Malcolm S. Forbes

As I said in another connection: "An excellent plumber is infinitely more admirable than an incompetent philosopher. The society which scorns excellence in plumbing because plumbing is a humble activity and tolerates shoddiness in philosophy because it is an exhalted activity will have neither good plumbing nor good philosophy. Neither its pipes nor its theories will hold water."

—John W. Gardner,
Excellence, Can We be Equal and Excellent Too? [1]

PATENTS AND TRADEMARKS

If there is anything in the world that can really be called a man's property, it is surely that which is the result of his mental activity.

—Attributed to Arthur Schopenhauer. Unverified.[1]

Next came the Patent laws. These began in England in 1624; and, in this country, with the adoption of our constitution. Before then [these?], any man might instantly use what another had invented; so that the inventor had no special advantage from his own invention. The patent system changed this; secured to the inventor, for a limited time, the exclusive use of his invention; and thereby added the fuel of *interest* to the fire of *genius*, in the discovery and production of new and useful things.

—Abraham Lincoln[1]

If a man write a better book, preach a better sermon or make a better mouse-trap than his neighbor, tho he build his house in the woods, the world will make a beaten path to his door.

—Ralph Waldo Emerson

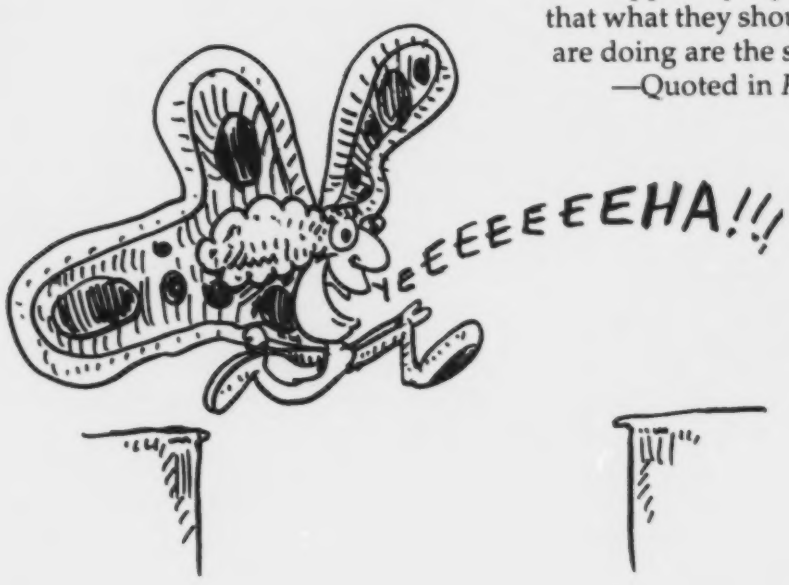
HAVE FUN

Our inventions are wont to be pretty toys, which distract our attention from serious things. They are but improved means to an unimproved end,...We are in great haste to construct a magnetic telegraph from Maine to Texas; but Maine and Texas, it may be, have nothing important to communicate.

—Henry David Thoreau, *Walden* [1]

The happiest people are those who discover that what they should be doing and what they are doing are the same thing.

—Quoted in *Reader's Digest*, Nov. 1982



To love what you do and feel that it matters — how could anything be more fun?

—Katherine Graham

Creativity is intelligence having fun.

—Anonymous

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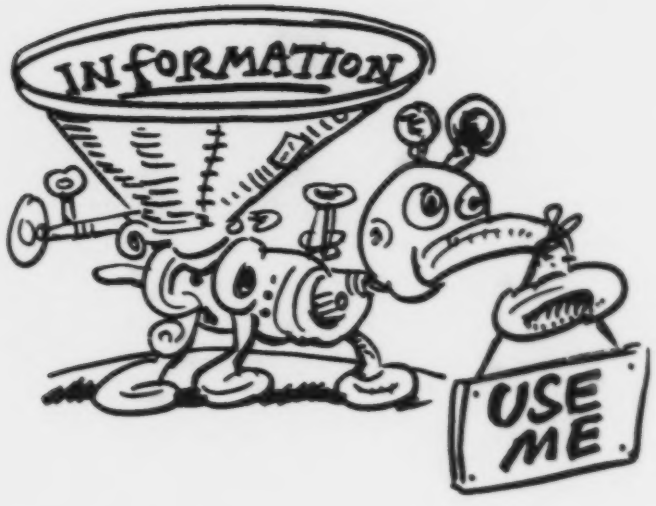

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Creative Problem Solving and Inventing

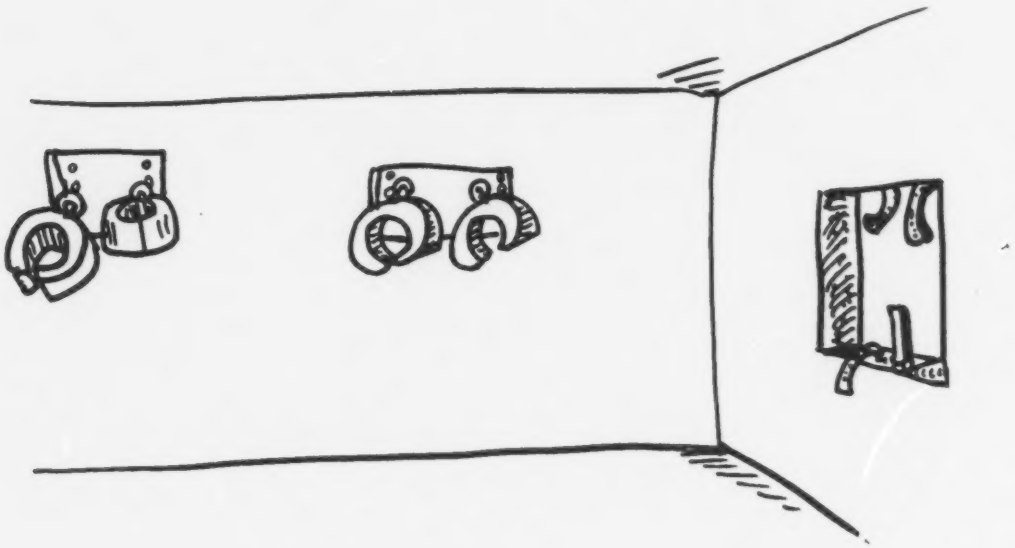
Dr. Donald J. Treffinger
and
Grover Young

Dr. Donald J. Treffinger

Dr. Treffinger is President of the Center for Creative Learning in Sarasota, Florida, and Professor of Creative Studies at Buffalo State College in Buffalo, New York. He is an educational psychologist who has long been interested in recognizing and nurturing creativity and Creative Problem Solving among children and adults. He has been a teacher at the elementary and middle school levels, and a faculty member at Purdue University and the University of Kansas. Dr. Treffinger is the author or co-author of more than 200 published articles, monographs, and books on creative learning and problem solving. He is a member of the Educational Advisor panel of Inventure Place (Home of the National Inventors Hall of Fame), and the educational advisory board of the National Inventive Thinking Association.

Grover Young

Grover Young teaches students, teachers, administrators, and parents. His specialty is creating opportunities for recognizing, nurturing and celebrating the unique strengths, talents, interests and potentials of all students, staff and community members. He served as Gifted and Talented Program Coordinator for Holt Public Schools in Holt, Michigan for twenty-one years where he developed a comprehensive inventive thinking program. Grover is currently a consultant to school districts across the nation and an active member of NITA. He is an associate of the Center for Creative Learning in Sarasota, Florida.



Creative Problem Solving and Inventing

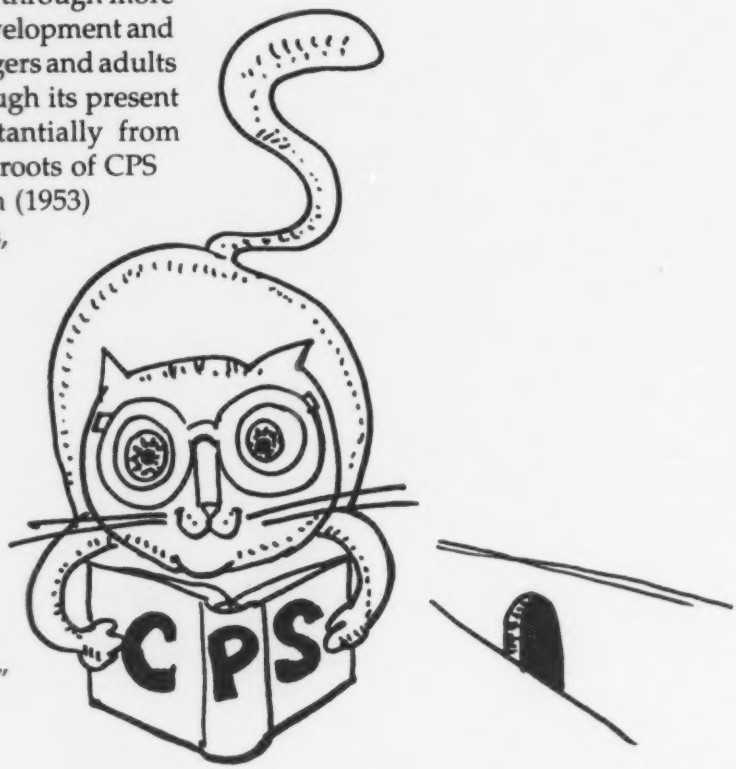
Dr. Donald J. Treffinger and Grover Young

What Is CPS?

This section illustrates several practical ways to use Creative Problem Solving (CPS) to support and enhance inventive thinking in the classroom. In our work, we distinguish between "creative problem solving" and "Creative Problem Solving." The former, using lower case letters, is generic; it represents any efforts made by an individual or group to use their creativity to solve a problem. We use the latter phrase, with upper case letters (or the capitalized acronym, CPS) to refer to our specific model or framework for creatively defining problems, generating options and planning for implementation (Treffinger, Isaksen, & Dorval, 1994; Isaksen, Dorval, & Treffinger, 1994). Many of the activities and applications presented in this chapter could very easily be adapted to fit the vocabulary and approach of other models. For consistency and clarity, however, we will refer to our approach throughout this section.

Today's CPS model has emerged through more than four decades of research, development and practical use with children, teenagers and adults (Isaksen & Dorval, 1993). Although its present structure and use differs substantially from previous versions, the historical roots of CPS are found in the work of Osborn (1953) and Parnes (1967, 1981; Parnes, Noller, & Biondi, 1977; Noller, Parnes & Biondi, 1976) as well as in our own previous research and writing (e.g., Isaksen & Treffinger, 1985).

The contemporary representation of the CPS model involves three components, six specific stages, and a metacognitive or planning dimension we describe as "task appraisal and process planning" (Isaksen et al., 1994).



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The three major components of CPS are: *Understanding th e Problem, Generating Ideas,* and *Planning for Action.* Within the three components there are six specific stages. Understanding the Problem includes *Mess-Finding, Data-Finding,* and *Problem-Finding.* Generating Ideas includes *Idea-Finding,* and the Planning for Action component includes *Solution-Finding* and *Acceptance-Finding.* The Task Appraisal and Process Planning dimension guides the problem solver in choosing appropriate components or stages for dealing with a particular task or challenge under the existing circumstances in which CPS will be used. This framework is summarized in **Figure 1.**

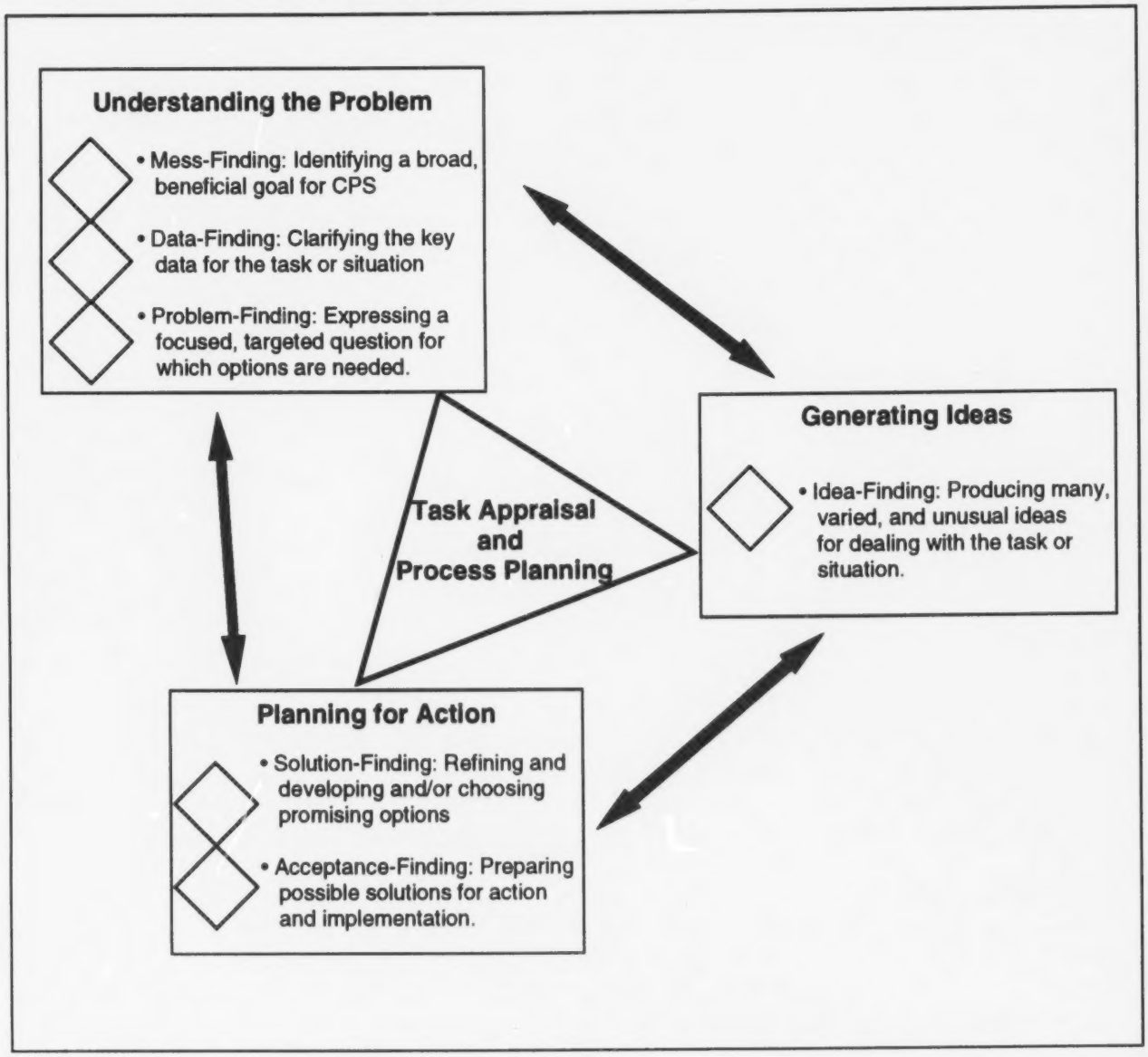
Understanding the Problem
• Mess-Finding: Identifying a broad, beneficial goal for CPS
• Data-Finding: Clarifying the key data for the task or situation
• Problem-Finding: Expressing a focused, targeted question for which options are needed.
Generating Ideas
• Idea-Finding: Producing many, varied, and unusual ideas for dealing with the task or situation.
Task Appraisal and Process Planning
Planning for Action
• Solution-Finding: Refining and developing and/or choosing promising options
• Acceptance-Finding: Preparing possible solutions for action and implementation.

Figure 1
Creative Provlem Solving (CPS) Model
Adapted from Treffinger, Isaken, & Dorval (1994)
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Today's uses of CPS challenge individuals and groups to set aside some traditional understandings of the nature and process of problem solving. For example, if you have ever learned any structured approach or model for problem solving, the chances are good to excellent that you learned it as a "stage" model or a series of prescribed, sequential steps: first you define the problem, then you generate and evaluate options and finally you choose and verify the best solution.

We have enough experience and evidence today to propose that such rigid, linear, prescriptive models have now exceeded their useful lifespan. We are replacing them with more sophisticated "independent components" models of problem solving. When you take into account several important preparation or "front-end" factors (who's involved, the task or goals, the situation and the variety of process strategies available), you can make a good decision about whether to use *any* of the components at all, and, if so, which ones and in what order. It is also evident that different groups, for varying purposes and under unique circumstances, may very well begin with any of the components, use them in varied sequences, and exit in different ways.

Sometimes you need to define the problem and so the methods in the stages of the Understanding the Problem component are appropriate and necessary to use. However, on other occasions, you may already have a very clearly and specifically defined problem to begin with so your CPS efforts may well start with Generating Ideas. In yet other circumstances, you may have a number of creative and appealing options so your primary need or goal is to prepare them for successful implementation and action. This might lead you to work only, or initially, in the Planning for Action component.

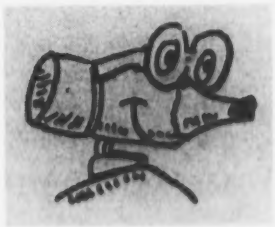
In any CPS session, within any of the components or stages, it is also important to monitor your activity and progress, asking, "Is this working? Are we moving forward or in the intended direction? Are we attaining clarity and confidence in the steps that should be taken?". These metacognitive or process management activities will help you to decide which additional CPS stages (if any), will next be most helpful to use. Your work in any component can lead you to any of the other components; the pathways among the components are not "one way streets." Thus, when working on generating ideas, it might be clear that some promising options are ready to take forward to Planning for Action. But it might also become evident that the problem needs to be modified or broken down into smaller or different sub-problems, in which case you might turn next to Understanding the Problem. The stages and components of CPS are not intended to portray any single, fixed order or sequence of steps.

We should also note that, although we discuss "Creative" Problem Solving, effective use of CPS involves both critical and creative thinking in every component and stage. Creative and critical thinking are not mutually exclusive skills that are inconsistent or incompatible with each other; they are complementary operations that should be regarded as working in harmony to foster productive thinking and more effective problem-solving. In each of the six CPS stages, there is both a *diverging* phase (generating options or ideas; "creative" thinking), and a *converging* phase (analyzing, refining, and choosing ideas; "critical" thinking).

Linking CPS Components and Stages to Inventing

In this section, we will describe a number of classroom activities and exercises that can be used to help students understand and relate CPS components and stages specifically to inventing. (The authors of this chapter acknowledge with thanks the ideas and suggestions offered by many participants in NITA's July, 1994 Working Meeting in Branson, Missouri for this section.) These lists are intended as examples, and not as a comprehensive collection of activities.

It is also important to emphasize that the activities suggested below are only starting points. The power and value of CPS will not be realized completely until students can apply the process to real inventing challenges. These activities are intended, then, to help students ***learn*** and ***practice*** CPS methods and techniques. CPS has been used successfully to deal with many different kinds of real problems, challenges and inventing opportunities (Treffinger, 1994b).



Use PLTS #2 with these activities in order to help identify students who observe skillfully and deeply.

Sample Activities: Understanding the Problem

Understanding the Problem involves dealing with situations in which you need to define, clarify or structure a task or problem. A "problem" can be a concern or a difficulty—something that isn't right—but it can also be an opportunity or a challenge—something that's working well, but can be made even better. Activities for this CPS component help students learn and practice finding, clarifying and defining opportunities or challenges on which they might need or want to work. The activities can involve three kinds of effort:

- Locating broad areas of opportunity or concern such as aspects of daily life that need improvement or enhancement (Mess-Finding).

- Examining any task or situation in many ways and from many different perspectives (e.g., considering Who? What? When? Where? Why? and How? for any task), in order to understand the "key" or most essential aspects of the challenge or opportunity (Data-Finding).

- Developing many possible specific problem statements in formats that invite many ideas (such as "In what ways might..." or "How might...") and selecting or constructing one to use as a focus of the group's problem solving (Problem-Finding).

The following list offers some "idea starters" for learning and practicing the skills of Understanding the Problem. Practice activities can help students understand the CPS components and stages and how to use them this way, these activities can help prepare students to deal more effectively with real problems and challenges.

1. What this classroom really needs is....

2. Inventing Opportunities: The Million Idea Machine. [Brainstorm ten possibilities in each of four categories, such as "type of invention, goal of invention (verb), goal (object), target audience." Then, select random combinations of one item from each column— "mix and match"— to consider as a possible invention. There are 10^4 or 1,000,000 possible combinations.]

3. List things that need improving at home, in the neighborhood or community or any other designated place.

4. Make many observations of the playground and how to improve it.

5. Listening to people: what are their wishes, desires, needs and complaints?

6. Use the media to locate common problems and opportunities.

7. Conduct multi-generational interviews about life, times, activities, inventions and needs.

8. List classroom and school situations that need improvement.

9. Attend and listen at local government meetings (e.g., student council, school board, city council, C-Span); list problems and challenges you hear being considered.

10. Use all of your senses: what needs for inventions are suggested by anything you hear, see, taste, touch or smell?

11. Use journal writing, personal idea logs or any other kinds of "idea catchers" to capture new opportunities or challenges for which inventions are needed.

12. Use drawing to illustrate the current state (how things are now) and desired future state (how you'd like things to be) for any topic; then, in the middle, begin drawing thoughts about what's needed to help you get from here to there.

13. List ways to make life better or easier.

14. List needs of people in other countries; think about challenges faced by people in Third World countries.

15. For any opportunity, problem, or challenge, list all the data you can find. Include what you know, and what you need or want to know.

16. For any area of improvement list many possible problem statements.

17. Analyze TV programs to identify "messy" situations—opportunities or challenges that need to be addressed (look at what the programs do include, and think also about issues or themes that might arise...).

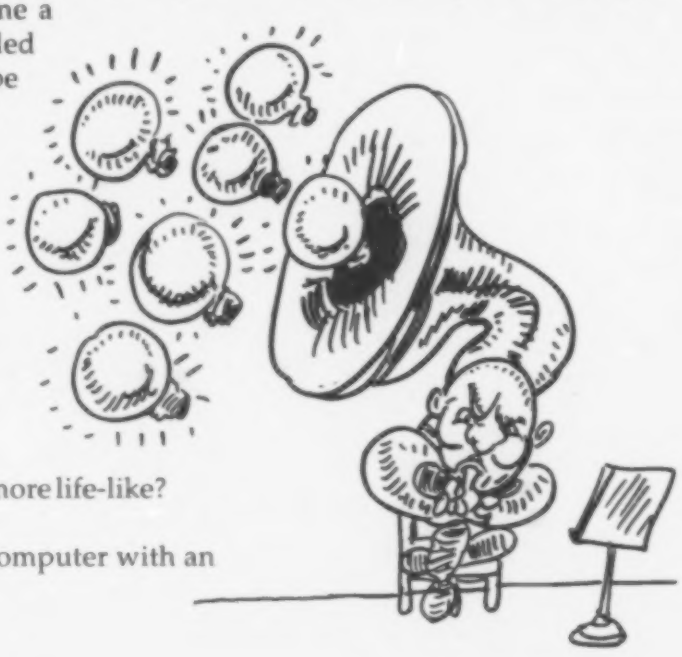
18. Identify many possible new problems or challenges that might be found in any story, historical event or situation, or in the content of any textbooks.

19. List many different environmental issues or concerns that suggest needed directions for new inventions.

Use PLTS #4 with these activities in order to help identify students who know how to generate and analyze activities.

Sample Activities: Generating Ideas

Generating Ideas involves thinking of many, varied or unusual possibilities for any task or problem statement for which new options are needed; it includes the Idea-Finding stage of CPS. The focus of your effort in this stage is on thinking creatively. Brainstorming, which is the specific theme of the section by Evie Andrews and Andi Williams Case in this book, is one strategy that can be used to generate options. There are also many other techniques for diverging or generating options, including attribute listing, force-fitting or forced relationships, idea check lists, morphological matrixes or metaphors and analogies (cf., Davis, 1992; Treffinger, 1994a). Regardless of the techniques or strategies to be used, it is important to frame a question or task that is open-ended and invites many ideas. It can be helpful to begin the questions with an "invitational stem" such as In What Ways Might... [IWWM...], or How Might... [HM...], or to use a question or statement such as, "What if..." or "Just suppose that..." Some examples of possible questions to practice idea generation are provided in the following list.



1. IWWM we make lessons more life-like?

2. What if we combined a computer with an overhead projector?

3. HM we improve student desks, work areas or lockers?

4. IWWM we improve the lunchroom?

5. Identify the kinds of movements people make/ HM we use these to design new equipment?

6. IWWM students and teachers make school life better?

7. List many different kinds of (or reasons for) alarms.

8. List many different shapes (forms... colors...) you can find at a shopping mall (amusement park... school...).

9. List many ways to improve your life by changes that might be made in various categories (e.g., environment, objects, time, places...).

10. Create and use role play or dramatization of various situations or events to stimulate idea generation for a question or problem statement.

Use PLTS #4 with these activities in order to help identify students who know how to generate and analyze activities.

Sample Activities: Planning for Action

Planning for Action involves refining and developing promising ideas, forming intriguing ideas into potential solutions, examining possible sources of assistance (support) and resistance (blocks or obstacles) in the implementation of solutions and creating specific Action Plans for promising ideas and solutions. For any new ideas or solutions, some of the questions or strategies you might practice include:

- Examining the criteria that would be important to use in analyzing, refining, or strengthening any of the products, ideas, or solutions, and applying those criteria to them.

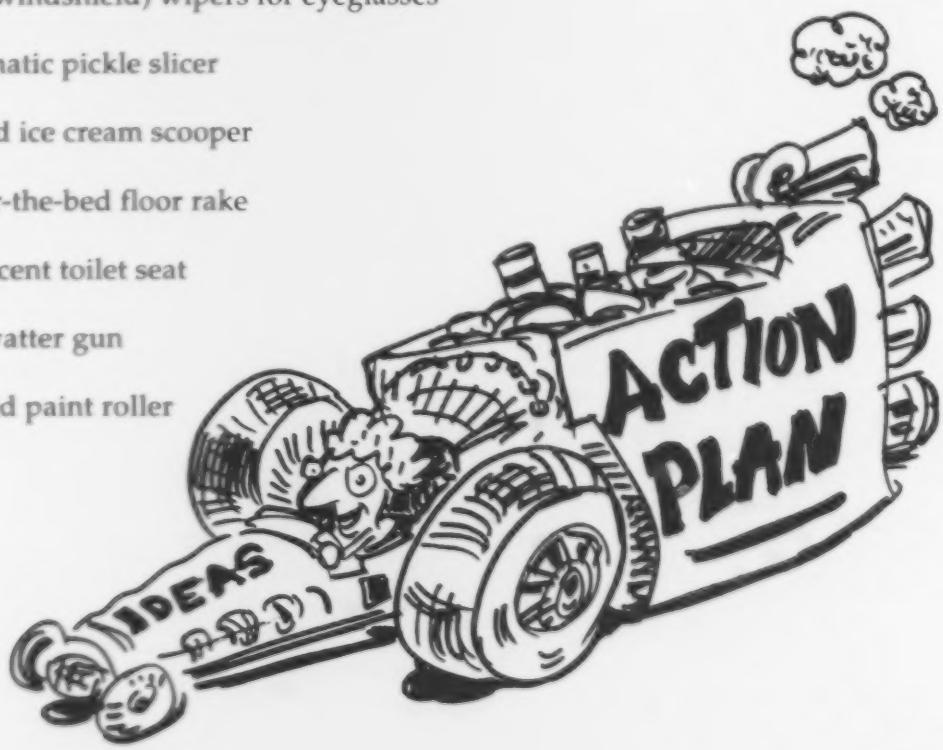
- Considering possible sources of assistance (Who would support or help advance this idea? What would be good ways to promote the idea? When or where might the best times or places to introduce or promote the idea? Why should anyone be interested in the invention or need it? How might the benefits and advantages of the product or idea best be presented?).

- Considering possible sources of resistance (Who will be opposed to the idea or product? What concerns or limitations must be overcome? When or where might be the poorest times or places to introduce or promote the idea? Why might the idea not work? What might go wrong? How can these concerns be prevented or overcome?).

- Create a specific Plan of Action for developing, producing, marketing and/or promoting this new idea or invention.

The list below provides examples of unusual ideas or inventions for which students might practice applying *Solution-Finding* or *Acceptance-Finding* strategies.

1. chocolate chess set or chocolate game board (e.g., Chocolate Monopoly™)
2. unbreakable taco shell (See Michele Munson's section in this book)
3. device to "catapult" toilet paper (for use at trees, houses, football games, etc.) with reversible remover
4. combination wrist watch, fax machine and TV remote unit
5. shirts or jackets with zippers on the *bottom* of pockets
6. stick on the wall (Vertical) bowling for apartments
7. lens (windshield) wipers for eyeglasses
8. automatic pickle slicer
9. heated ice cream scooper
10. under-the-bed floor rake
11. florescent toilet seat
12. fly swatter gun
13. lighted paint roller



Other Linkages Between CPS and Inventing

CPS can also be applied in a number of other ways that will support inventing programs in school settings. Adults can use CPS to help plan or design an inventing program in a school or district that does not already have such a program and to expand the program or enhance the activities or support base for existing programs. Of course, any program, as a normal course of its operation and development, will encounter a variety of obstacles, problems, and unexpected challenges. Deliberate use of CPS methods can help you to deal with these constructively and efficiently. CPS can also be helpful in planning for new directions and maintaining commitment to innovation and continuous improvement in programs that are already functioning smoothly and successfully.

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An Interactive Approach to Help Develop Inventors

(and to sneak in a little history)

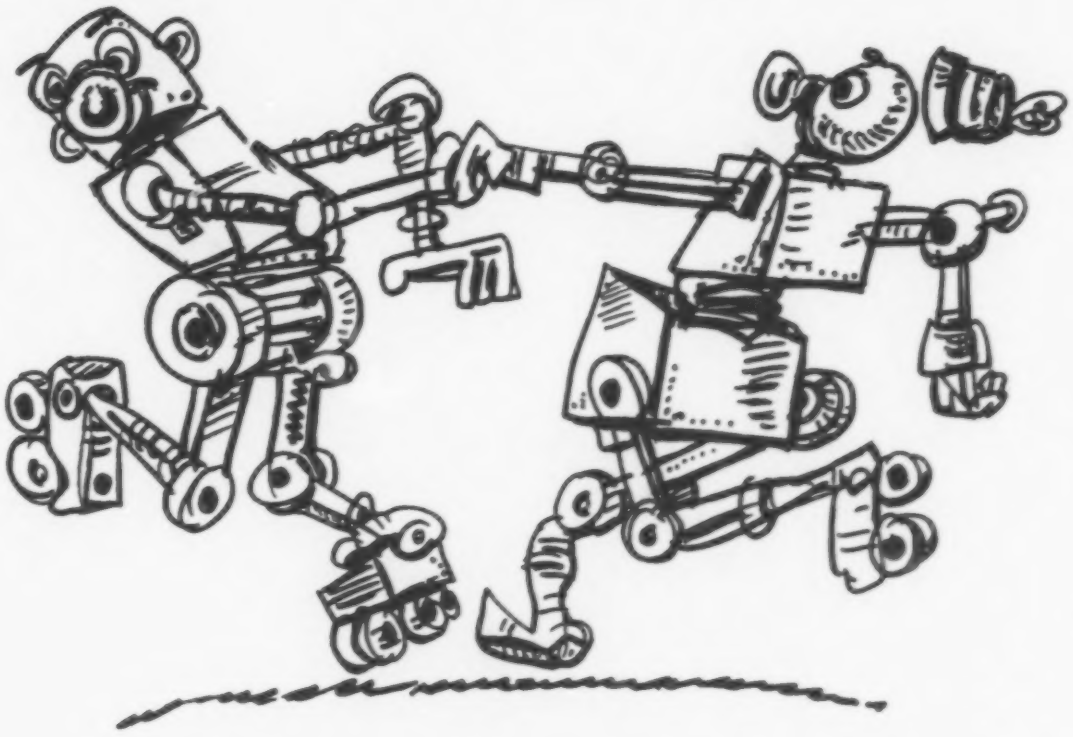
Dr. Fred M. B. Amram
and
Sandra Amram Brick

Dr. Fred M. B. Amram

Dr. Fred M. B. Amram is an award winning professor of speech communication and creativity. He is currently Director of Academic Affairs of the General College, University of Minnesota. He has authored books and articles relating to creativity, women inventors, robotics and communication. Professor Amram has been curator of several exhibitions displaying the achievements of women inventors. Thirty years of employment experience in industry and education has led to consulting activities on several continents.

Sandra Amram Brick

Sandra Amram Brick is a working artist who has taught inventing/creativity in the United States, Europe and Southeast Asia. Ms. Brick has designed exhibitions about women inventors for the University of Minnesota and the U.S. Patent Office. She is a trainer, consultant and published author with special interest in empowering girls—and helping boys appreciate the inventiveness of girls, so that women will work in a supportive environment.



An Interactive Approach to Help Develop Inventors

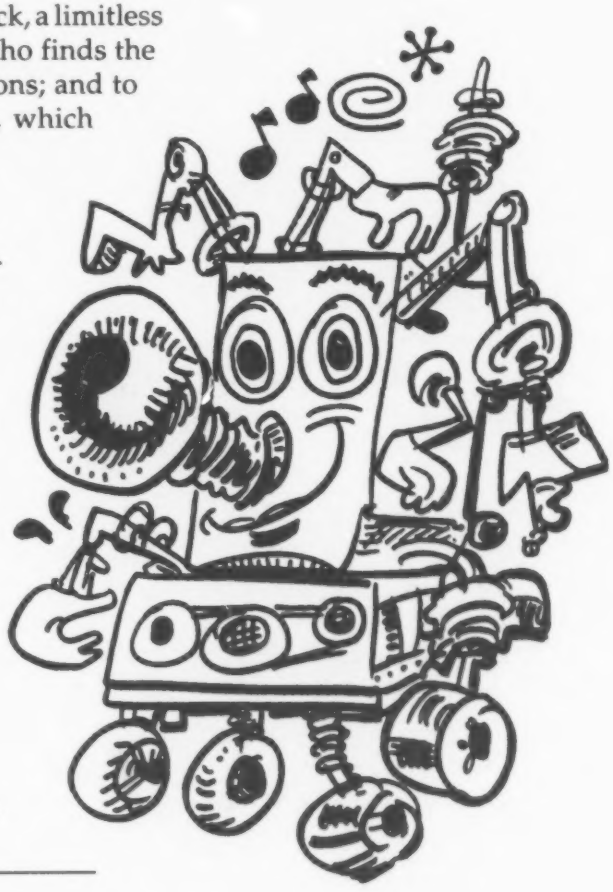
(and to sneak in a little history)

Dr. Fred M. B. Amram
in collaboration with
Sandra Amram Brick

The exercises in this section may be used freely and the stories may be retold. Credit to the author is, of course, welcome. Images (pictures) appear at the end of the section and may be reproduced in paper or transparency form.

The author is grateful to Sandra Amram Brick, a limitless resource of ideas; to Jacqueline V. Reid, who finds the information and who makes the illustrations; and to Mary Ellen Gee for her inspired editing, which reaches beyond grammar.

This section invites reader participation. Write and/or draw in the spaces provided, in the margins and anywhere that feels comfortable. If you join in, you'll have more fun. Teachers, students, parents—everyone is welcome to join in.



In the space below (or wherever you like) write the names of five inventors. What did they invent? How did their inventions change their social and/or physical environment?

_____

_____

_____

_____

_____

BEST COPY AVAILABLE

Now, look around. Identify some items that have been invented:

Naming inventors is difficult because we don't easily recognize that almost everything around us is a product of human invention. Those inventors that we know are the exceptionally prolific or those who have had an especially good "press."

Later we'll return to the spaces in which you've written the names of inventors. We'll look at why you chose the inventors you did and suggest that we may want to spread the gospel of creativity more vigorously in order to enhance human innovation.

In the meantime we present our theme: Invention, history of technology and women's studies can all be explored, and taught, as a single interdisciplinary package.

INVENTION

...and on the first day God created the heavens and the earth.

Use PLTS #6 with this activity in order to teach about and self-assess the principles of openness and courage.

The Problem Comes First

Identify five or more problems of interest to you. Some may be "people problems" (e.g., How can I get my brother to be more polite? How can I persuade my supervisor to be more supportive of my creative efforts?). Others may be "thing problems" (e.g., How can I open the front door when I'm loaded down with grocery bags? How can I build a better mousetrap?).

Did you identify problems related to railroad tracks? Photography from spy planes? Preventing grizzly bears from damaging transformers in the Alaska wilderness? Perhaps not. You discover problems as you experience them. You are challenged by your special experience. You begin to be an inventor when you take ownership of the problems which face YOU.

Constance Moore is an Arizona resident who loves to play tennis daily. The Arizona sun is very hot. She also likes to wear lipstick. Ms. Moore experienced a problem. At the end of a tennis match when she went to the clubhouse, she discovered that her lipstick had melted in her purse. Do other women in hot climates experience this problem? Of course. Perhaps you could earn some money if you could solve the problem. Stop a moment and IMAGINE some solutions. What advice can you give Ms. Moore?

In 1983 Constance Moore received a patent for a Refrigerated Lip Stick Container. She used a solution close at hand. By joining two small plastic medicine vials, one inside the other, and placing "blue ice" in the space between them, she created a cooler for her lipstick. In the evening she puts her cooler in the freezer. In the morning she places her lipstick in the device and carries it in her purse. After a day in the heat the lipstick is still cool and firm. After some attractive designing and creating of professional molds, and after receiving a trademark for the Koolips name, her product was ready for the market *(see image #1)*.

When Jennifer Horowitz was a young girl, her family did not fit easily around the dinner table. Poor Jennifer had to sit at the corner. Her chair bumped the table leg and consequently, she never got close enough to the table. Jennifer was confronted by a problem in her immediate environment. What could she do? List some suggestions.

Image #1

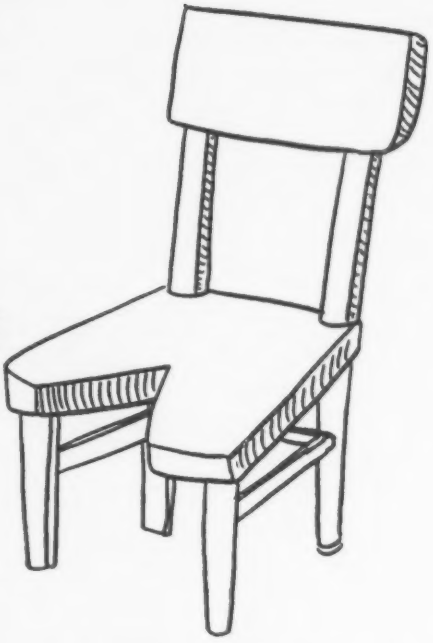


Image #2

Jennifer cut a piece out of the seat front of an old chair and now could place the chair close enough for easy reach *(see image #2)*.

While the home inventor generally solves problems close at hand, the organizational inventor may be assigned a task. Barbara Askins, a NASA scientist, was assigned an interesting problem. Spy planes fly over foreign lands to take photographs. They fly extremely fast and the photographer takes pictures from great distances—perhaps two miles above the object. Picture quality suffers. What do you suggest? What are some options?

A physicist might want to tinker with the camera or the lens. Barbara Askins, a trained chemist, approached the problem as a chemist would. She invented a process to be used in developing films to "make the blacks blacker and the whites whiter." Patent #4,101,780 reads in part:

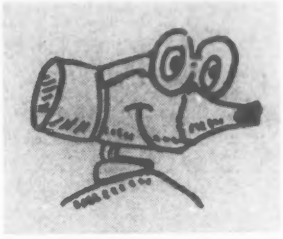
> *A method of obtaining intensified images... comprises the steps of converting silver of the developed film or plate to a radioactive compound...; placing the treated film or plate in direct contact with a receiver film which is then exposed by radiation from the activated film; and developing and fixing the resulting intensified image on the receiver film.*

The process when applied to X-rays helped to increase safety by minimizing exposure time. Another popular application enriched faded and aged personal pictures just as it enriched poor-quality pictures taken from great heights. Can you think of other uses for the Askins' patent?

Most often problems are "discovered" in one's environment—as in the case of Jennifer Horowitz. Sometimes problems are assigned to the inventor—as in the case of Barbara Askins. On rare occasions a discovery has no apparent application. It becomes a solution in search of a problem.

Such was the case when someone at a 3M laboratory spilled a chemical on a tennis shoe. The spot remained cleaner than the rest of the shoe. When the shoe was washed, the chemical remained in the fabric and continued to protect the spot from dirt. No one could get the chemical off the tennis shoe. Some people might simply throw the shoe away. Some might see the situation as a challenge. What would you do?

Some inventors at 3M decided to translate this unexpected event into a problem-solution situation. Lots of research and modification of polymers led Patsy Sherman and a colleague to receive patents for diverse versions of a fabric protector with the trademark name of Scotchgard®. Now one can protect couches, rugs and clothes from dirt.



Use PLTS #7 with this activity in order to assess the principle of observing skillfully and deeply.

When identifying problems, it's important to solve the "real" or significant problem. For example, you ask, "How can I build a better mousetrap?" Have you identified the REAL problem? Why do you want to build a better mousetrap? "To get rid of mice," you say. Then the problem might be stated as, "How can I get rid of mice?" and you have an enormous array of possibilities (including building a better mousetrap).

Or you may want to improve the mousetrap so that "the world will beat a path to your door." The REAL question might then be stated as, "How can I get the world to beat a path to my door?" or "How can I become wealthy (or famous)?" By asking why you want to solve the problem as first stated, you may discover a more interesting or a more important problem.

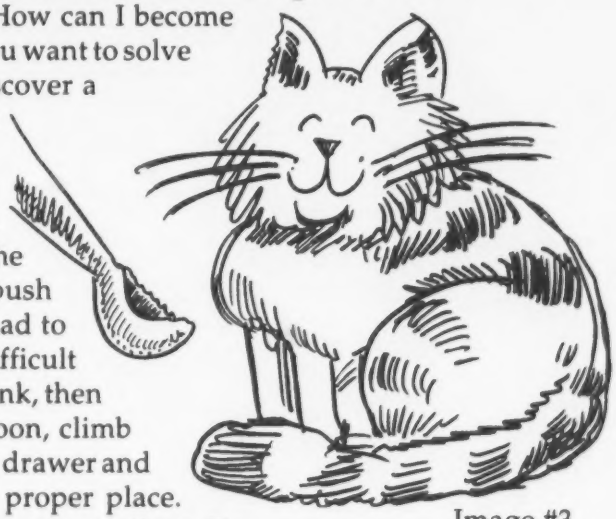
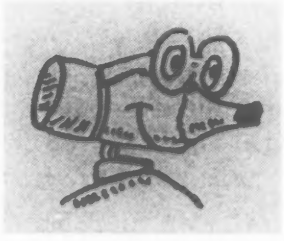


Image #3

Suzanna Goodin at age seven was responsible for feeding the family cat. She opened the tin of food, used a spoon to push the food into the cat dish and then she had to wash the spoon. That, for a little girl, is a difficult task. First she has to bring a chair to the sink, then climb up, reach the faucet, wash the spoon, climb down, dry the spoon, put the spoon in the drawer and finally she must return the chair to its proper place. Suzanna had a problem and thought about some options. Do you have some ideas? But first, what was her problem? Use the space to state Suzanna's problem in the form of questions?

One great idea was to simply lick the spoon clean and put it back into the drawer—until her mother caught her. Suzanna's stroke of genius was in redefining the problem. Instead of asking, "How can I clean the spoon?" she asked, "How can I get rid of the spoon?". A whole new array of ideas comes to mind. List a few alternatives.

With a teacher's help, Suzanna made a biscuit-spoon, much like a dog biscuit. After using her spoon to push the food from the tin into the dish, Suzanna fed the spoon to the cat. Suzanna, her mother, and the cat were all happy *(see image #3)*.



Use PLTS #10 with this section in order to teach about and self-assess the principle of listening to their "inner voice."

Solutions Come from Inside You

People are afraid to invent because they believe that inventing requires "creating the heavens and the earth." We know only those inventors who made a dramatic breakthrough. However, almost all of the roughly 5,400,000 patents granted in the United States during the past 204 years were simple improvements of existing products or processes. Technology is incremental and therefore each small advance leads to another small advance which, in turn, leads to . . . and so on. Everyone can be an inventor simply by building on old technology. Constance Moore, for example, built on the existing technology of "blue ice."

A patent can even be granted for a new use of an existing product, such as the use of aspirin as a growth enhancer for pigs. Caroline Brooks received a patent for an "improvement in the methods of producing lubricated molds in plaster." She used butter as a lubricant.

Students of invention must learn—must internalize—that everyone can invent and that each invention is simply an improvement on prior technology. Then the task becomes less awesome or frightening.

Solutions, like problems, come from ourselves. Our solutions develop in the context of our own time and place—our own knowledge and skill. Barbara Askins and Patsy Sherman solved problems by seeing their world as chemists—creative chemists, to be sure, but chemists all the same.

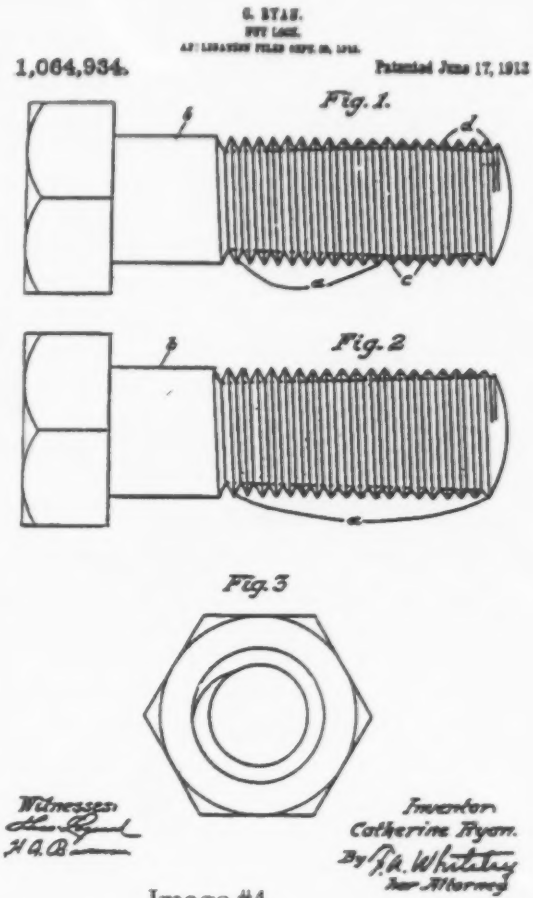


Image #4

Catherine Ryan had little scientific training, but still solved a sophisticated problem by recognizing a solution within her own environment. One day, while strolling along a railroad track with her husband, she noticed railroad men walking along, tightening the bolts that held the track to the ties. At the time, much money and energy went into keeping the bolts tight. Indeed, many train and trolley accidents were caused by nuts that had loosened on their bolts. That night, while wondering about the problem, she noticed how her wedding ring was caught behind her knuckle. Instantly she envisioned a locking nut which she later had machined to her specifications. Catherine Ryan received six patents for versions of her locking nuts and lived to see the concept implemented on trolley tracks as well as railroads throughout the country *(see image #4)*.

From Knowledge to "Aha"

The process of inventing is not quite as mechanical and straightforward as we've painted it so far. There is an element of "magic" at which point we see the problem and/or the solution in a new way.

Arthur Koestler developed the idea of "bisociation." He pointed out that people like to think along a consistent "thought plane." However, he suggested, when we dare to allow one thought plane to intersect with a totally unrelated thought plane, we can come up with truly novel ideas.

Suzanna Goodin invented her edible spoon when she stopped seeing it as a tool to be used and cleaned and, instead, saw it as part of the cat's meal. Similarly, Catherine Ryan's technical solution came after she stopped thinking at the level of railroad bolts and was able to intersect her wedding ring with the concept of "holding securely."

In the early days of agriculture, farmer pushed plow. Doesn't it make "sense," then, that horses should push plows and reapers *(see image #5)*? It took a breakthrough to consider the possibility of putting the horse before the cart.

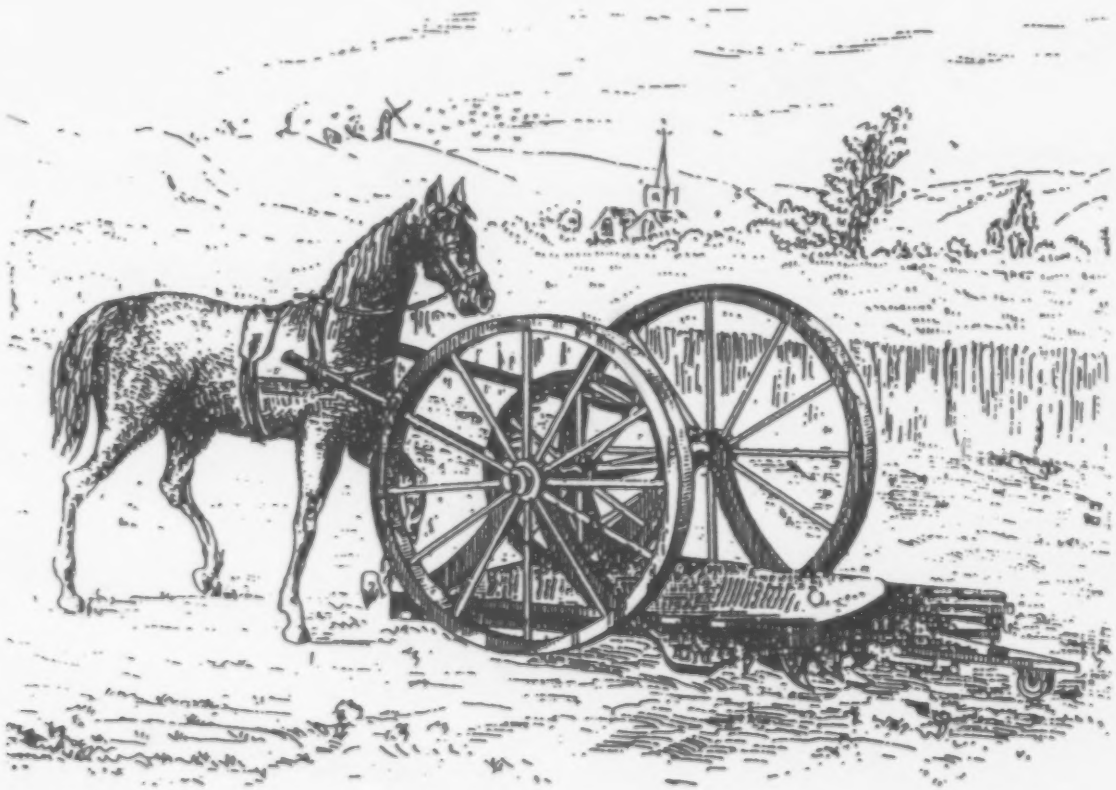


Image #5

Opening the Gates

Seeing the world in new ways where ideas are not comfortably related requires a temporary suspension of reality, a faith in the unknown and magical, a confidence in the potential of the human mind. Schiller argued that a key to creativity is leaving the gates to the mind open. Unfortunately, there are those who, even after a new idea has been proven, will continue to deny its possibilities.

Great speeches were delivered defending the horse over the untried new invention of the automobile. Scientists often close the gates to the possible. Right into the twentieth century, many argued that humans could never escape earth's gravity. Certainly they could never reach the moon.

And so when we ask our readers, or our readers ask their students, for options or possible ideas, we are asking that the gates remain open, that they dare to think the unthinkable.

Do It!

Taking an idea or invention from concept, or even patent, to market is a major theme worthy of its own paper. Here we simply try to explore a few ways one can bring an idea to market. A second theme is the need for appropriate design before one can achieve market success. Some inventors are true entrepreneurs, eager to market their ideas to a public. Others just want to invent while they choose to have others do the manufacturing and marketing.

An idea locked in the mind, or an invention hiding in the basement, is of no use to anyone. Inventions bring praise or profit to the inventor only when they become public. Inventions influence the way we live only if they are implemented. An old proverb warns:

> *He who is able to write a book and does not write it, is as one who has lost a child.*

The same is true of inventions. The creative act must be completed by implementing the creative idea—whether sonnet, symphony, novel or invention.

History of Technology

At the beginning of this section we proposed that while exploring and teaching invention, one can concurrently explore and teach aspects of the history of technology. Indeed, we have been doing just that.

The study of technological history examines how they relate, how technology and science are influenced by their environment and how technology impacts on the way people live. To a limited extent, we have touched on these issues; what remains now is to highlight them.

- **Problem identification and solution identification are functions of time, place and personal perspective.**

Child inventors see the world from their childlike perspective—that is perfectly appropriate for child inventors. We need to encourage students to become ever more aware of the many problems which surround them. Problem identification reflects the values, aspirations and fashions of the time. New types of hatpins were invented when large hats became more fashionable. Bette Graham's Liquid Paper® provides another fine example. The product was not necessary while typed images were erasable. The carbon ribbon created a need to "correct" mistakes in a new way because traditional erasing no longer worked. Recently a new formula for Liquid Paper® was created that responds to the need to "correct" photocopies. Will Liquid Paper® become obsolete as the computer, with easy correction and spell check, becomes more popular?

- **Invention builds on prior technology.**

The advances of theoretical science provide new insights to apply to technology. The Askins process for developing film was based on prior knowledge. The McCormick reaper patent cites prior patents, including one granted to William Manning—and there is significant evidence that the Manning Mower was really invented by his wife, Ann Harned Manning.

Not only do solutions reflect prior technology, but an inventor's solutions are limited by the prior technology he or she knows. In other words, inventors must have access to the training that teaches prior technology.

In diverse ways we have argued that technology is incremental. Consequently, it is important for inventors to know and understand what has come before. Furthermore, if we can internalize the fact that technology is incremental, we will be less awed by the frightening challenge to make an invention that parallels creating the heavens and the earth. As we become less afraid of inventing in small increments each of us can feel like a potential inventor.

Use PLTS #2 with this activity in order to identify students who observe skillfully and deeply.

- **The "magic" of the inventive breakthrough comes from seeing problems and solutions in new ways.**

We have already seen that Suzanna Goodin invented her edible spoon when she stopped seeing it as a tool to be used and cleaned and, instead, saw it as part of the cat's meal. Similarly, Catherine Ryan's technical solution came after she stopped thinking at the level of railroad bolts and was able to intersect her knuckle with the concept of "locking."

When Becky Schroeder was a young girl, she found herself sitting in a dark car waiting for her mom. She wanted to read and write her homework. Can you identify her problem? Can you state her problem in the form of a question? Perhaps you can state a few related problems.

Now, take a moment to find some options—some solutions—for her.

The use of a flashlight, if available, would be a solution. A disadvantage of the flashlight is that it distracts others. Becky's solution was an Electroluminescent Backing Sheet for Reading and Writing in the Dark. Over a period of several years, she was granted eight patents for improvements on her idea (*see image #6*). Commercially the item is called a "Glo-Board." After this chemically treated board is kept under a light for some time it holds a "glow" in the darkness, thus providing backlighting for paper placed on the board. The uniqueness of Becky's thought process is that she stopped looking for an outside light and tried to make the paper itself glow.

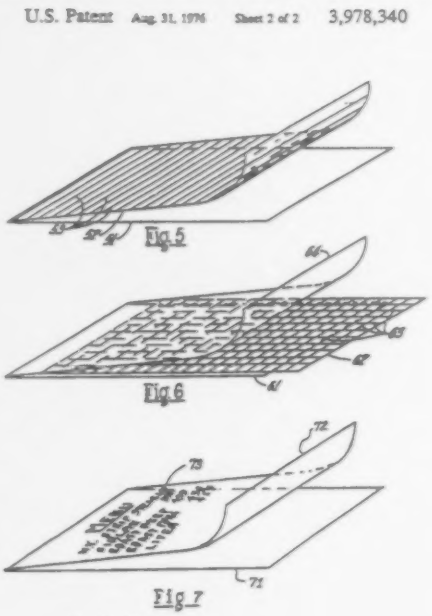


Image #6

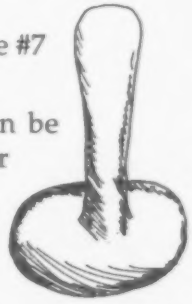
- **Invention impacts on how we live.**

In encouraging the implementation of ideas, we argue that an invention is of consequence to the society which surrounds it. While Jennifer Horowitz's special chair does not make a major impact on society or on culture, Patsy Sherman's Scotchgard® does. By protecting carpets, upholstery and clothing from dirt and stains, we can take greater risks with how we decorate ourselves and our environments. We can spend money on fabrics which we would not normally risk with children around. We can carpet areas which we would not normally carpet.

Another major invention that has changed the way we live is Kevlar®, a product with a tensile strength five times greater than steel. DuPont chemists had known about Kevlar® for some time, but could not extrude it into a fiber. Stephanie Kwolek, an outstanding and persistent chemist, found the way and now Kevlar is used in bullet-resistant vests, the skin of the Challenger Space Shuttle, tires, motorcycle chains, canoes, helmets, oil rig cables, fire hoses and so on. One can only begin to guess how many lives have been saved by Kevlar® products.

A Case Study

Image #7



The issues identified in the discussion of the history of technology can be demonstrated by reviewing the development of fabric pressing or smoothing. The term "pressing" comes from the early techniques for smoothing clothes which involved using a firm, smooth surface to rub on the fabric. Glass balls were sometimes rubbed on fabric to eliminate wrinkles *(see image #7)*.

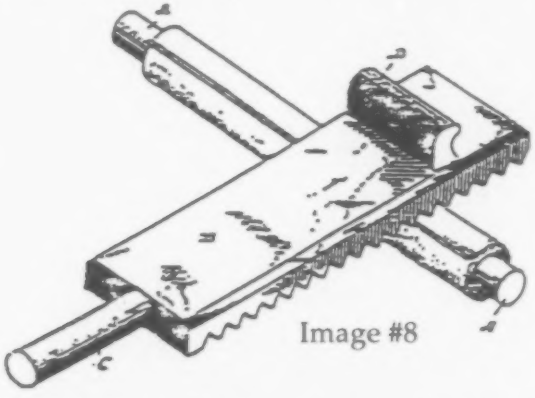


Image #8

A mangle patented by Rosa Koenig is a good example of the process whereby damp sheets, pillow cases, towels or other flat items were rolled on a smooth stick and then rubbed with another longer stick. Elbow grease provided the primary smoothing force *(see image #8)*.

In early Eastern cultures, an open metal dish with a handle was sometimes used. Coal or similar briquets would be placed in the open dish to heat the rubbing surface *(see image #9)*. Eventually the coals would be enclosed by covering the dish and creating a device known as a "hot box." Many of the enclosed irons had chimneys to enhance the circulation of air.

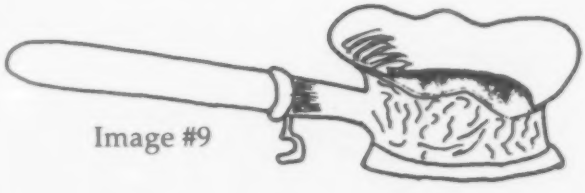


Image #9

Anna Niffeler patented an improvement on a tailor's iron which encloses the coal and has openings to provide helpful ventilation. Unfortunately, coal dust sometimes dropped out of the bottom holes, causing the freshly laundered fabric to become resoiled *(see image #10)*. These devices were called "irons" because they were made of iron, "flat irons" because the bottom was usually flat, "smoothing irons" to describe their function or "sad irons" to reflect the archaic definition of "sad" as "heavy."

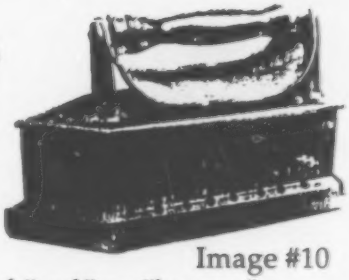


Image #10

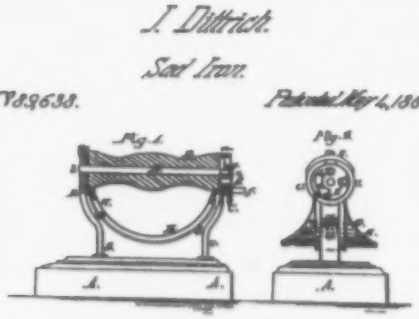


Image #11

The irons were usually quite hot and the rising heat burned the user's knuckles. Various improvements were patented, including a leather knuckle protector invented by Julie Dittrich *(see image #11)*.

Several special-purpose irons were patented, including a "polishing" iron by Mary Cook for rubbing starched shirt fronts. At the time of this 1848 invention, men's shirt fronts were starched and the starch was heavily polished. Ms. Cook noted that if she rounded the front, she could apply greater pressure by tipping the iron. An angled handle also made the iron more comfortable *(see image #12)*.

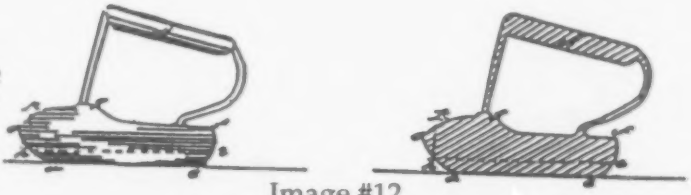


Image #12

Image #13

The Susan Knox fluting iron was designed to press the ruffles or fluted collars and shirt fronts popular at the time. It was quite a success and featured the inventor's picture on each iron *(see image #13)*.

As technology progressed, electric irons even included the spray option, as did an early steam iron by Gertrude Gross *(see image #14)*.

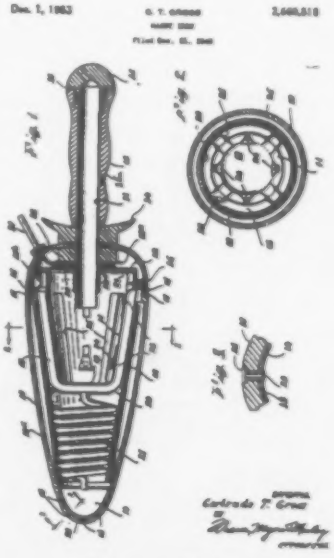


Image #14

As one reviews this little history of pressing irons, one sees that they were invented by women with personal access to the problem and that the solution came from relevant technology which was available to the inventors. Finally, one notices the cultural impact as the irons reflect the fashions of each period.

An interesting ending to this little history is that, although modern irons have become quite sophisticated, they are much less used today because of the inventions relating to cotton wash-and-wear clothing patented by Ruth Benerito and her colleagues at the Department of Agriculture.

The lessons about the history of technology are endless. Students can learn them while studying how to become inventive. These are important lessons about human endeavors in science and technology, told in the context of real cultures and learned in a pleasant and interesting manner.

Use PLTS #6 with this section in order to encourage a commitment to going against the odds.

Women's Studies

At the outset of this section we identified our theme: "Invention, history of technology, and women's studies can all be explored, and taught, as a single interdisciplinary package." When will we begin to focus on Women's Studies? We already have. Throughout this entire discussion, with the exception of Cyrus McCormick, we mentioned only women inventors. With some appropriate stressing of issues, the lessons will be easily learned.

Why focus on women inventors at all? In the entire 204 year history of the American patent system, about 5% of patents granted to Americans have been granted to women. In 1957, about 1.5% included the name of a woman. As recently as 1988, just over 5% of patents granted to Americans have been to women—and in 1993 the number approximates 8%.

Inventing is a statement of power. Women's powerlessness, however, has been taught as a cultural paradigm. Occasionally girls have been clearly and specifically taught that inventing is inappropriate behavior. In a 1970 children's book, a little boy is shown tinkering with tools and scraps. In a second illustration, a girl sits in a chair under a lamp clearly put together by the little boy. The caption under the first picture is, "Boys invent things." The second caption reads, "Girls use what boys invent."

We have learned that implementing inventions is important if one is to receive credit and reap fame and fortune. If, however, women are excluded from the marketplace and sources of financial backing, they are unlikely to become entrepreneurs.

We have learned that problem identification comes from the inventor's environment. Hence, if women are confined to the household, their inventiveness will be directed toward solving problems related to cooking, sewing and health care—and women did that remarkably well for many decades.

We have learned that solutions require some knowledge of prior technology. If women are excluded from equal education—especially technical and scientific education—their resources for problem solving will be limited.

Yet women do invent—although the credit often goes to their fathers, brothers and husbands. And we have seen that when women are trained as scientists and their environment becomes the 3M Corporation, DuPont or NASA, their contributions are impressive. We are now at the doorstep of empowering women so that they can become full partners in the creative arts and sciences. It is important to expedite this process.

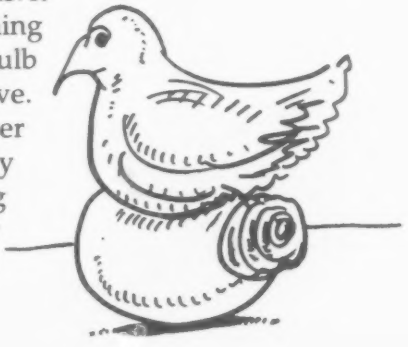
Throughout Western history we have lost almost half of humanity's potential inventors. Economic growth depends on new ideas, new products and new social inventions. We should not waste half of our potential. There is no evidence that women will invent differently—but they can be more active participants in the patenting process. We can double our options by doubling the number of ideas from which to choose.

> *The world cannot afford the loss of the talents of half of its people if we are to solve the many problems which beset us.*
>
> Nobel Prize Winner Rosalyn Yalow

Epilogue

At the outset of this section, we asked the reader to identify inventors and inventions. Likely, the inventors listed were mostly men. Of course! About 95% of patents granted to Americans by the U.S. Patent and Trademark Office have been granted to men. Yet we should try to identify more women inventors, if only to suggest to women that inventing can be women's work, and to remind men that they must see women as equal partners in the adventure of inventing.

We must become more aware of the many inventions around us, so that we become ever more conscious of what humans have created and can create. We must note clearly that inventions normally come in small increments and that everyone is capable of inventing. Even the light bulb was simply one in a series of technological advancements. It came after an understanding of vacuums, electricity, the burning of fibers and many other prior technologies. And the light bulb has improved from the first model and will continue to improve. Who will do the inventing? Everyone can, if we build greater consciousness of invention, place higher value on creativity and teach better problem-solving skills. By teaching creativity, we can also be teaching history of technology and Women's Studies, while spreading the gospel of invention.



LIST OF IMAGES

1. Sketch of "Koolips" patented and trademarked by Constance Moore. Illustration by Jon Pearson.

2. Chair designed by Jennifer Horowitz for Weekly Reader Contest. Illustration by Jon Pearson.

3. "Cat spoon" with happy cat. Spoon designed by Suzanna Goodin for Weekly Reader Contest. Illustration by Jon Pearson.

4. Drawing from one of six patents granted to Catherine Ryan for self-locking nuts and bolts. This patent was granted to Ryan in 1913.

5. Early reaper with horse pushing plow (circa 1800) Illustration from *The Growth of Industrial Art*, arranged and compiled by Benjamin Butterworth, Alfred A. Knopf, New York, 1972.

6. Drawing for one of eight patents granted to Becky Schroeder for luminescent backing sheets to help her write in dark environments. This patent was granted to Schroeder in 1976.

7. Glass ball with handle for "pressing" wrinkles out of fabric. Illustration by Jacqueline V. Reid.

8. Mangle for smoothing fabric. Drawing from U. S. Patent 506,436 granted to Rosa Koenig in 1893.

9. Chinese device used for smoothing fabric. Illustration by Jacqueline V. Reid.

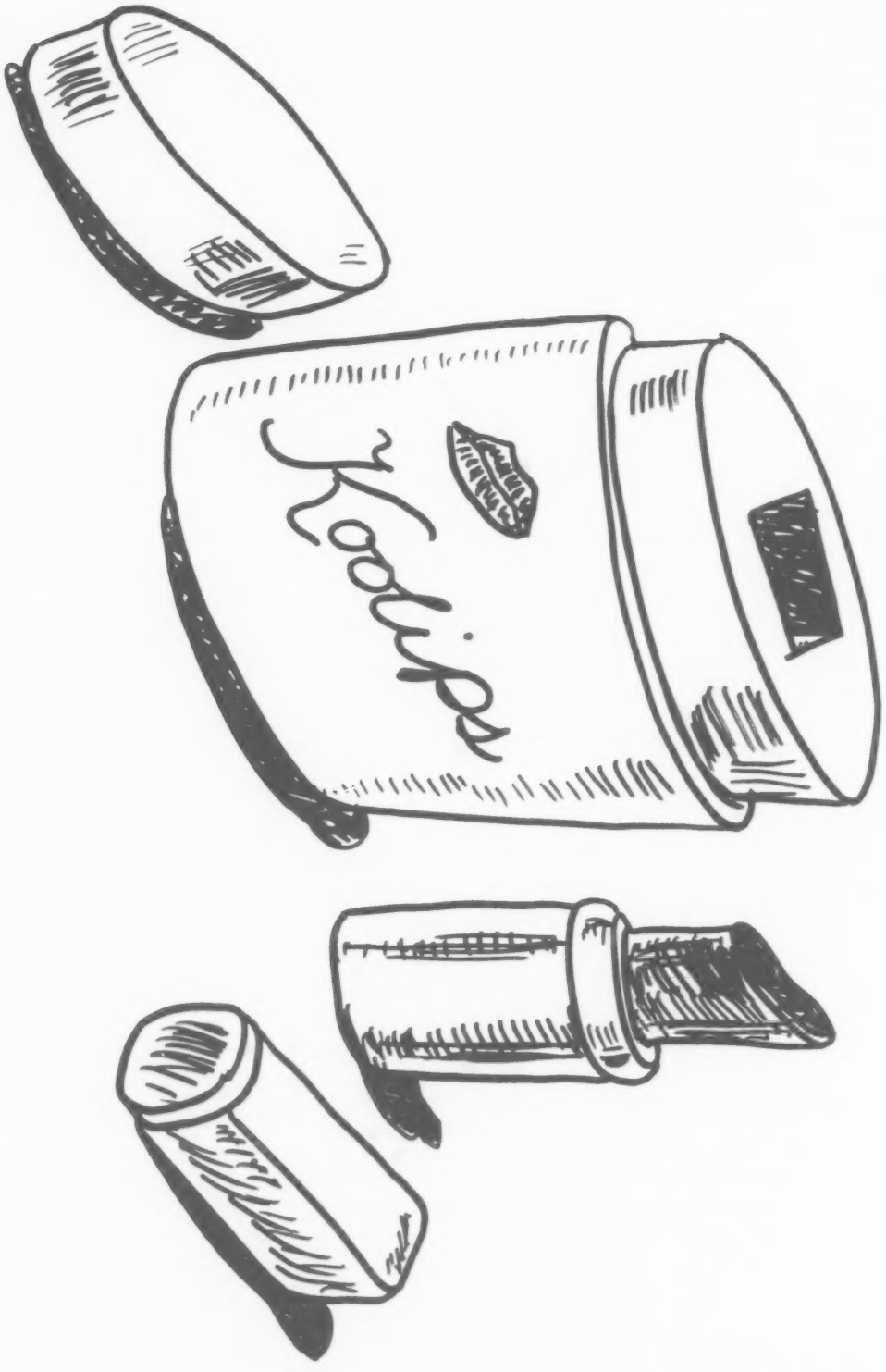
10. Anna Niffeler's iron was granted a design patent in 1868. Photo by Sandra A. Brick.

11. Patent drawing for an iron with knuckle guard. Patent granted to Julie Dittrich in 1869.

12. Drawing from a polishing iron patented by Mary Cook in 1848.

13. Drawing from one of two "fluter" patents granted to Susan Knox in 1866. Sketch of collar that might be ironed with a fluter.

14. Drawing from steam iron patent granted to Gertrude Gross in 1953.



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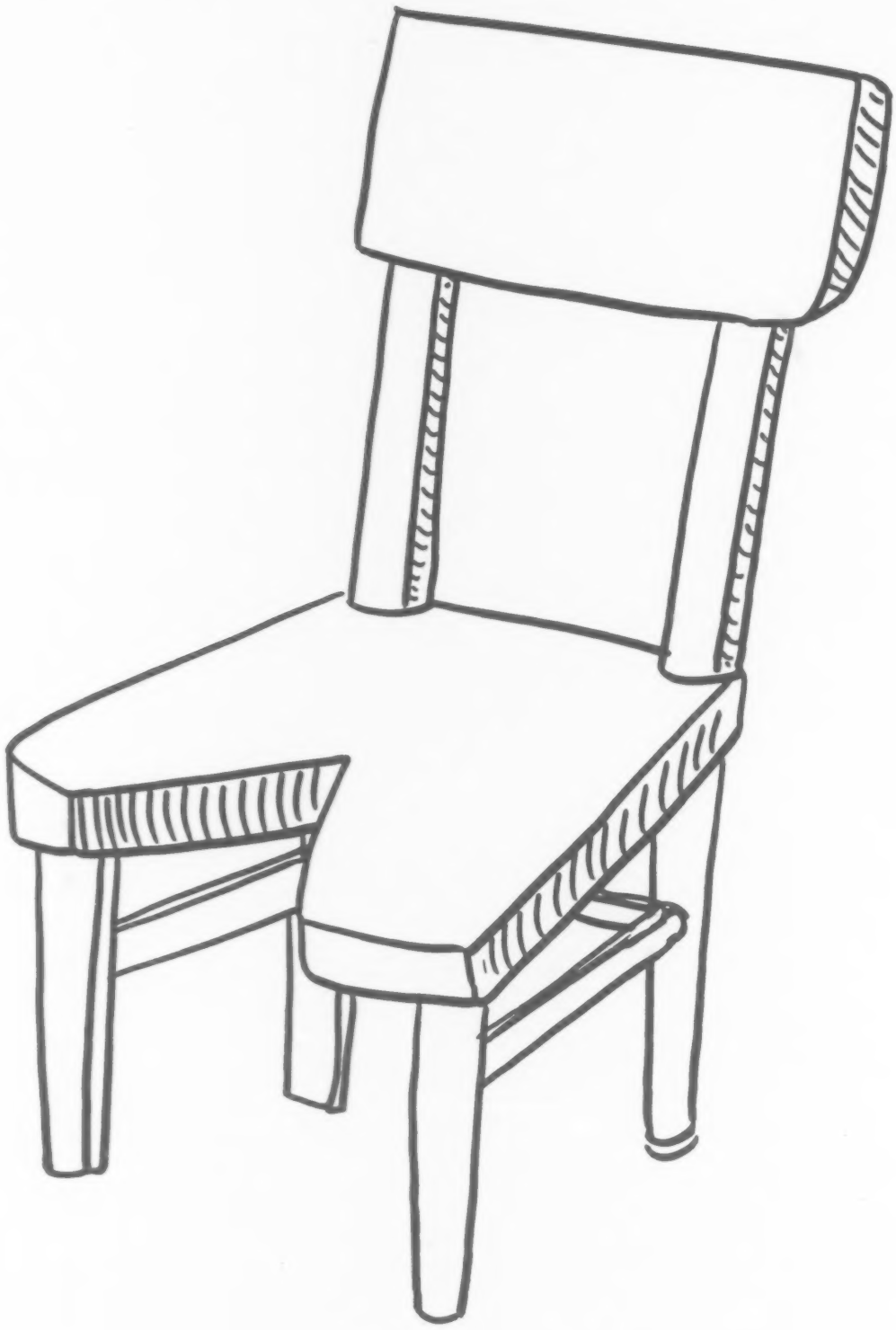

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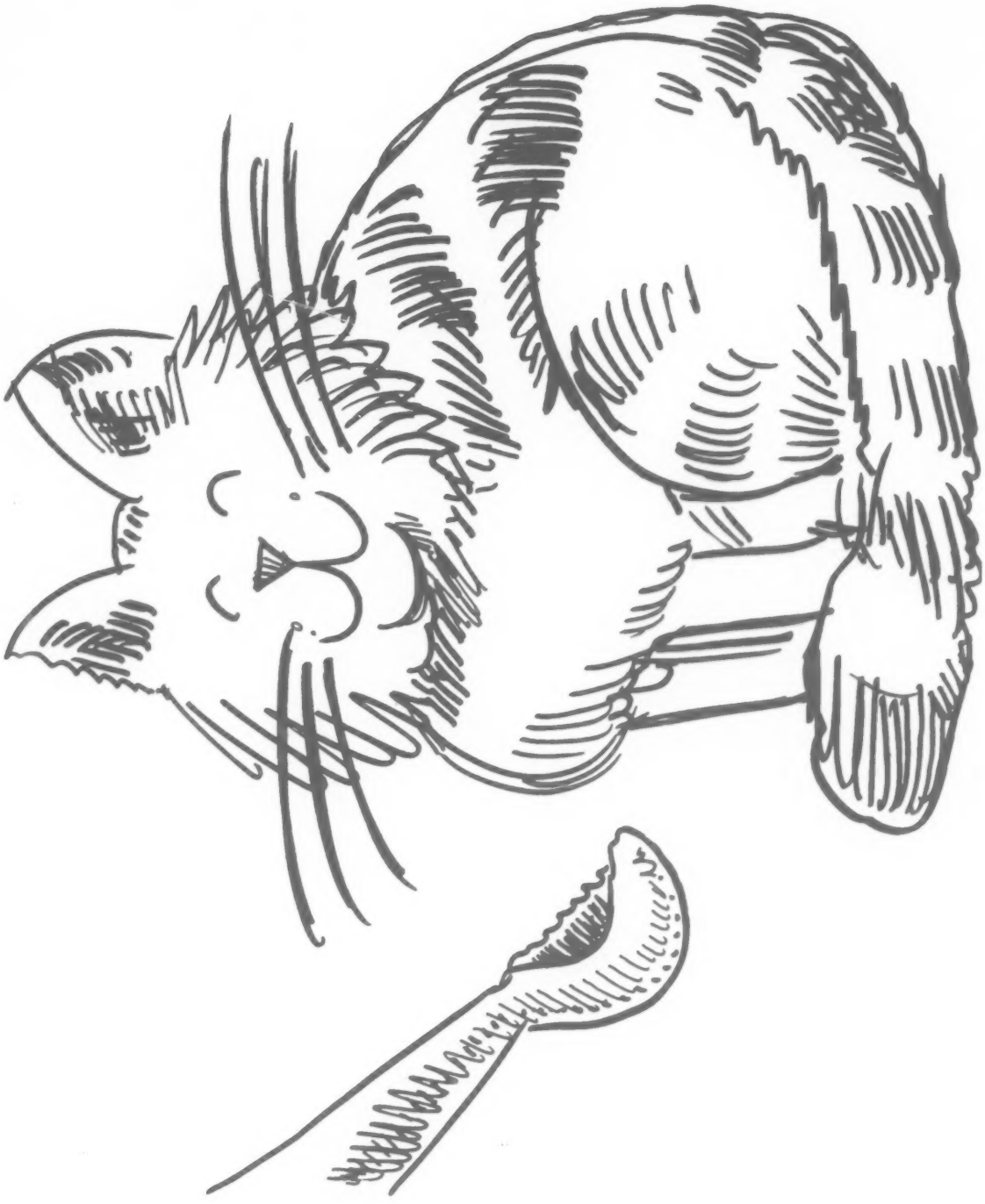

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C. RYAN.

NUT LOCK.

APPLICATION FILED SEPT. 30, 1912.

1,064,934. Patented June 17, 1913.

Fig. 1.

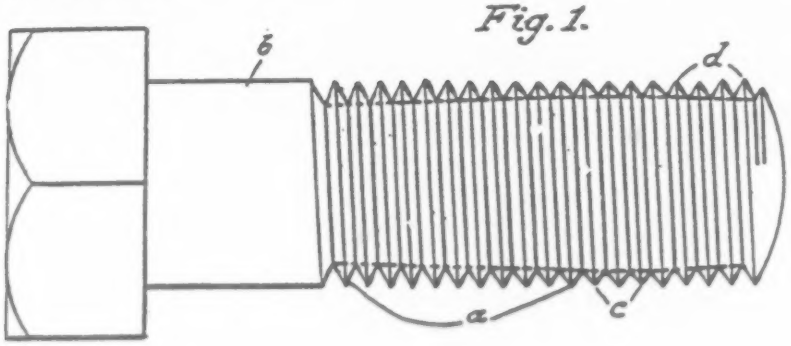
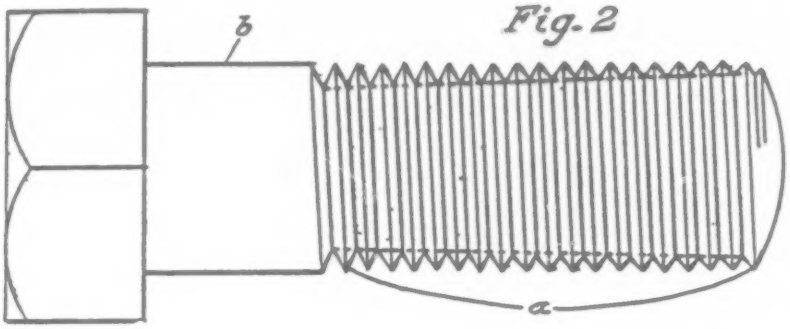


Fig. 2



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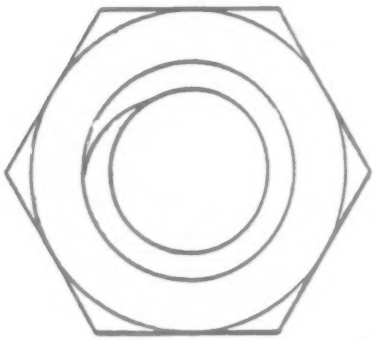
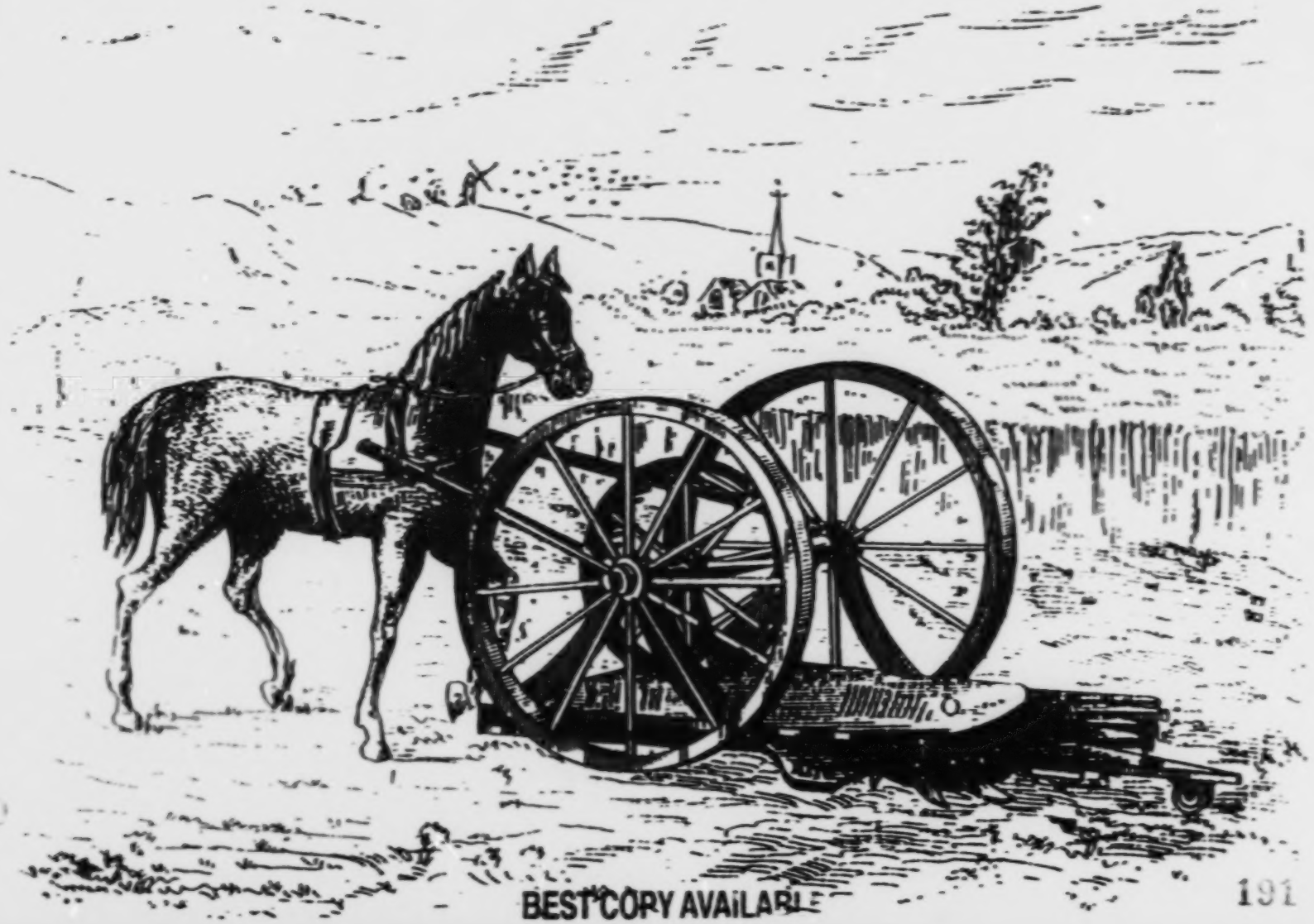


Witnesses:
Leo Ryan
H. A. B.

Inventor.
Catherine Ryan.
By F. A. Whiteley
her Attorney



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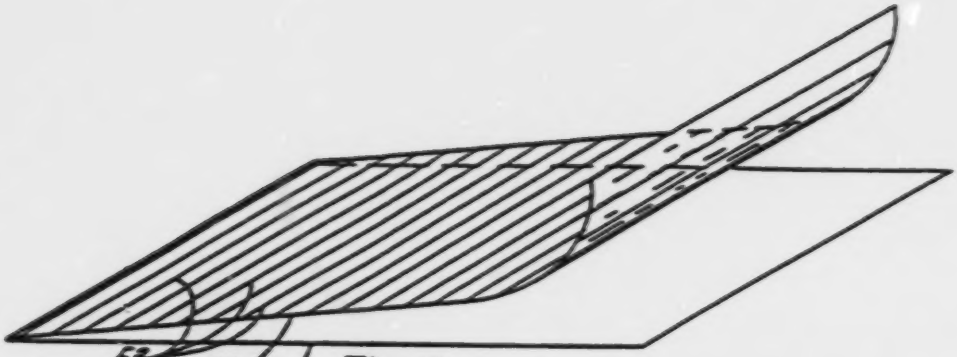
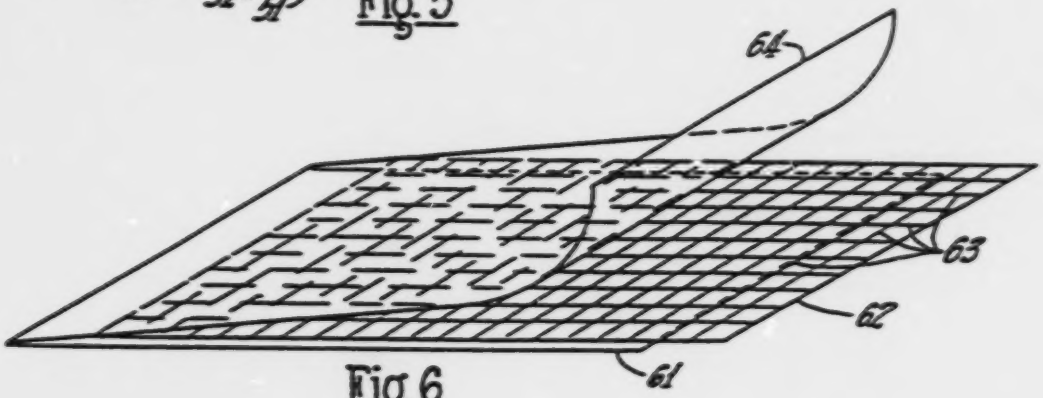


Fig. 5



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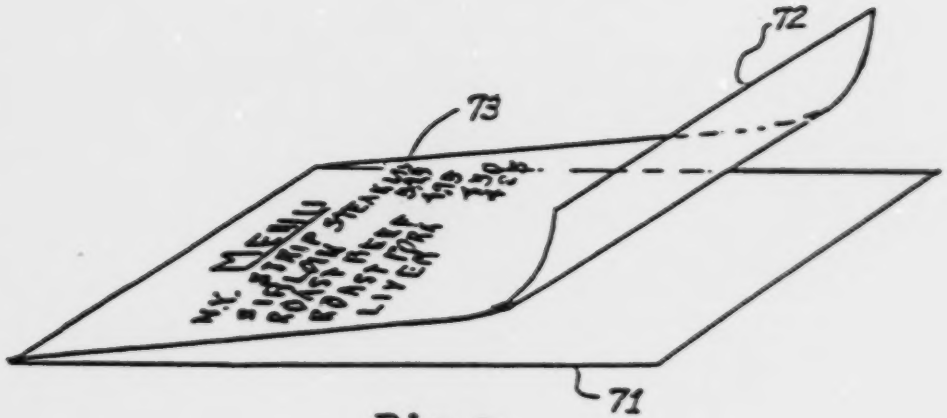

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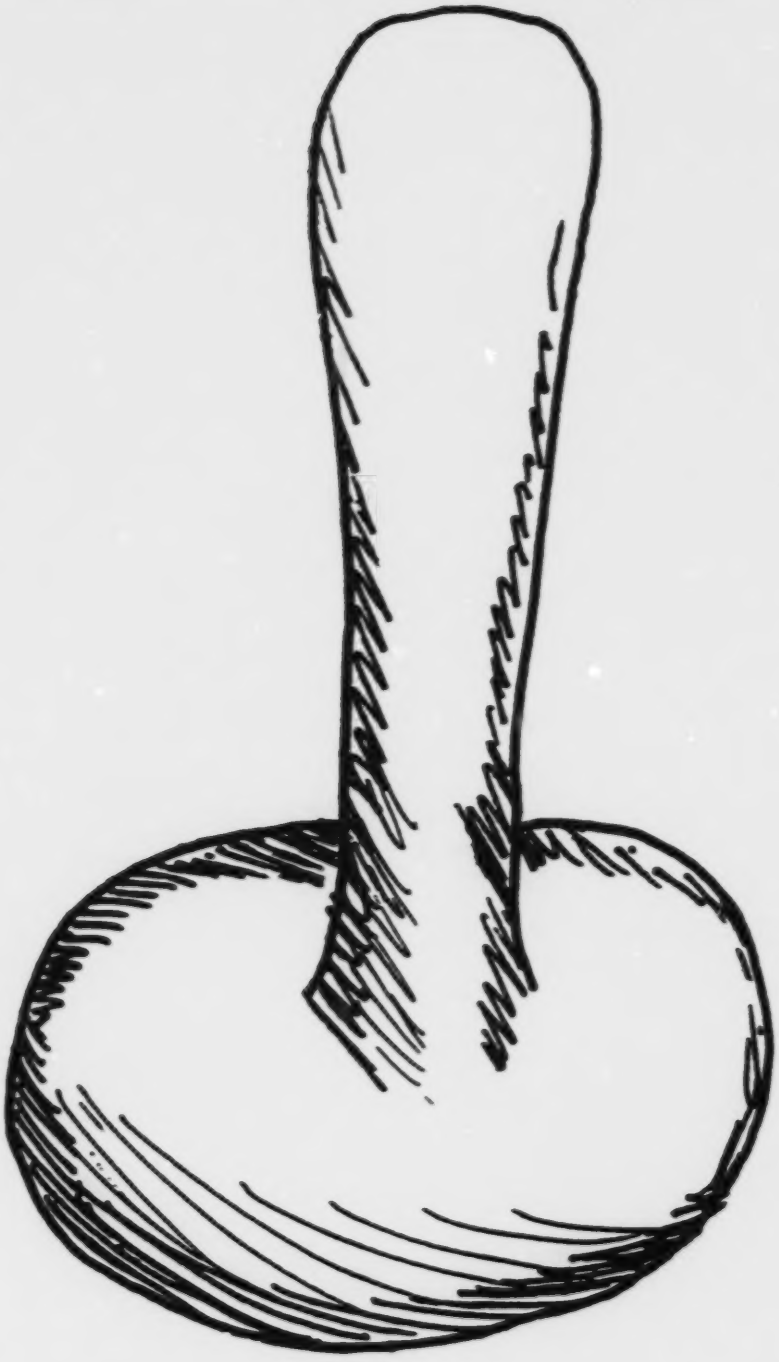

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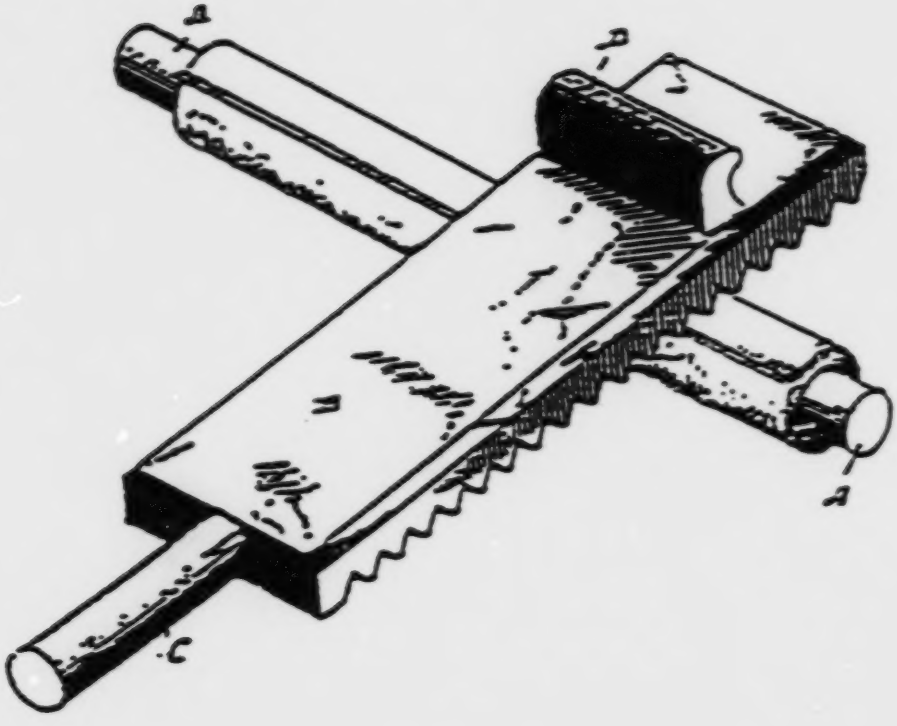

B
D
A
C

195

J. Dittrich.

Sad Iron.

No. 89638. Patented May 4, 1869.

Fig. 1.

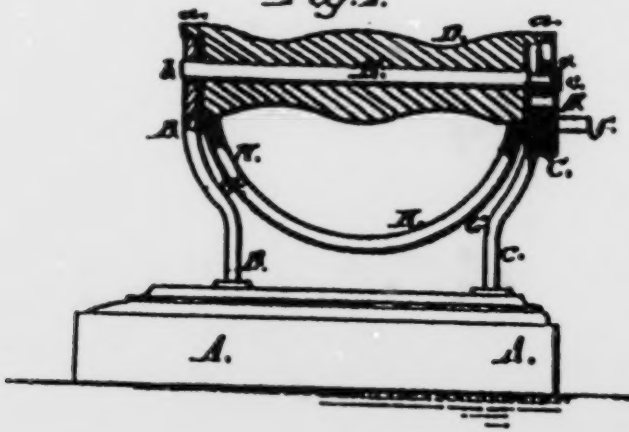
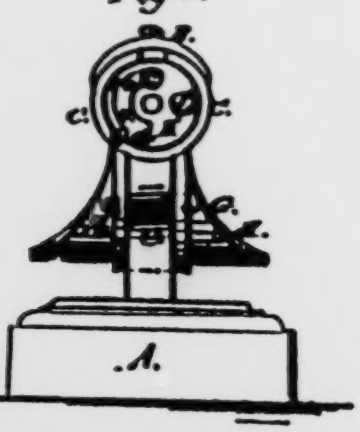
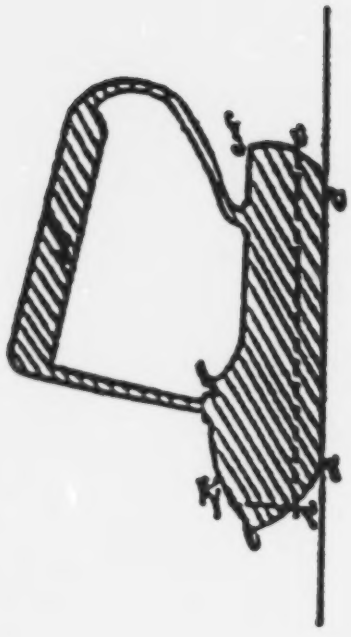
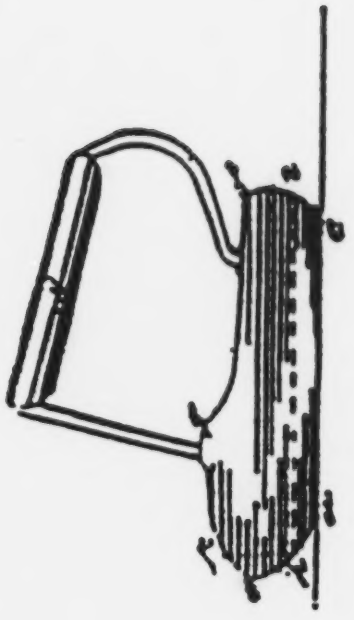


Fig. 2.







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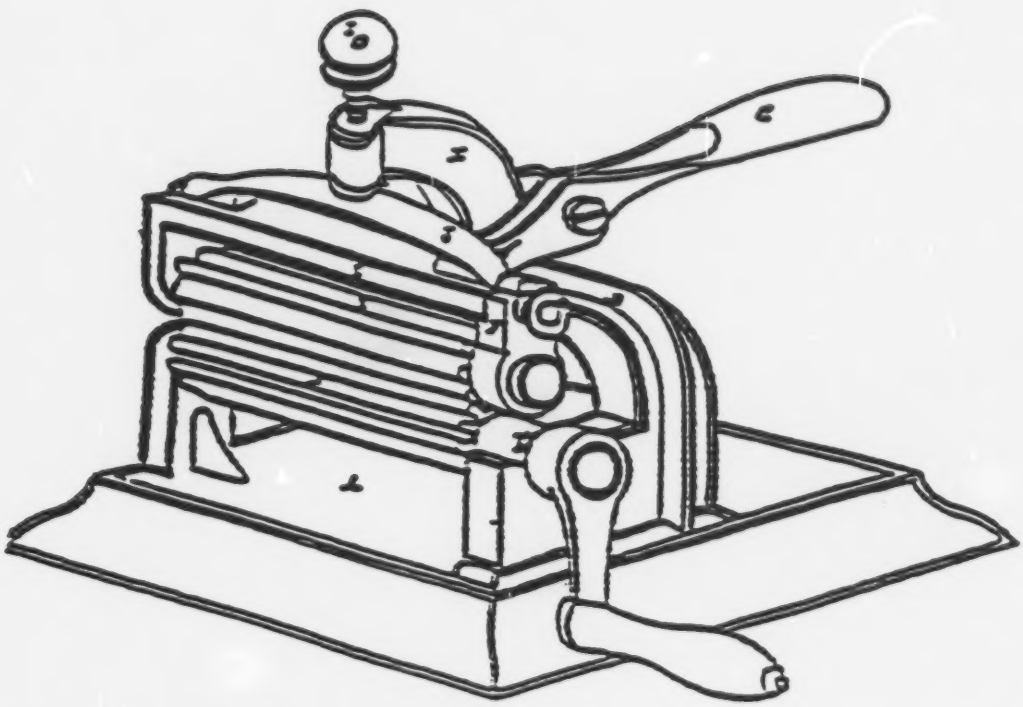
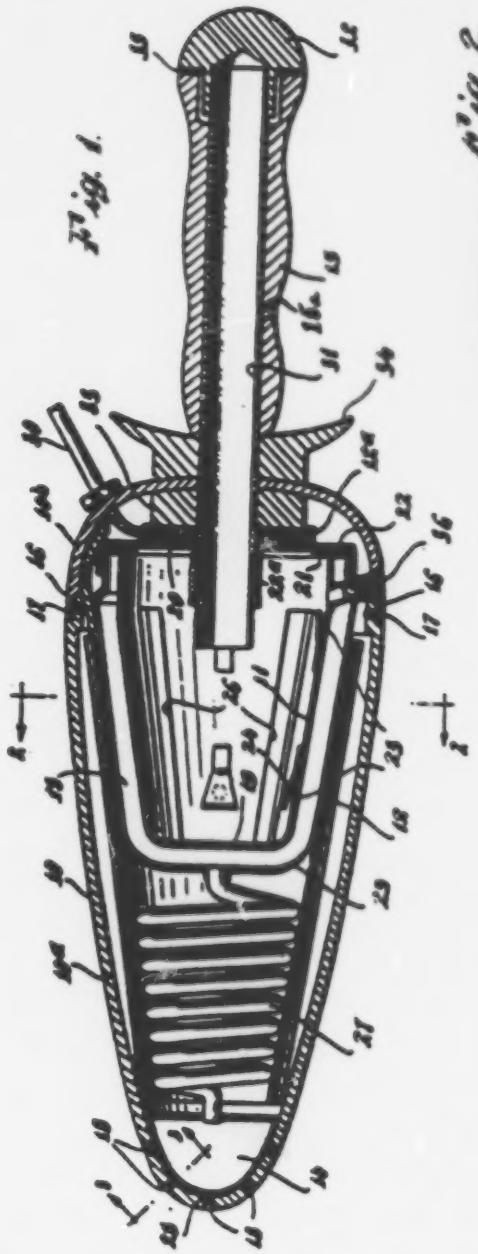


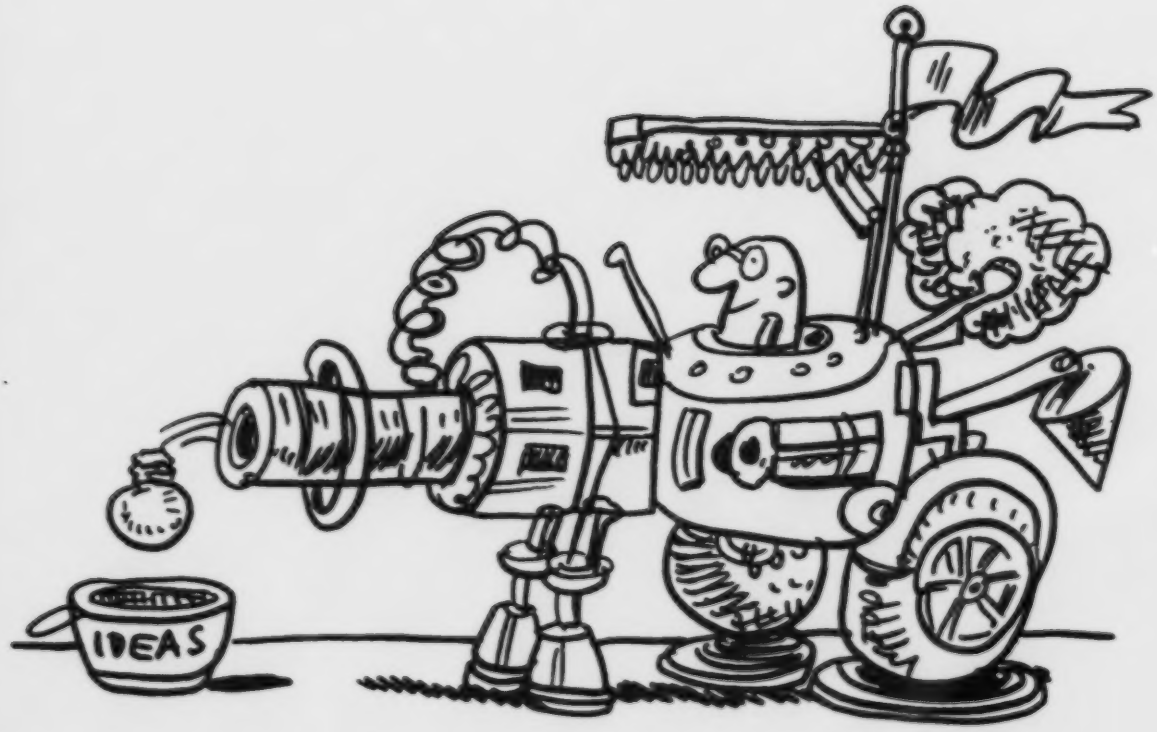
Dec. 1, 1953 G. T. GROSS 2,660,818

HANDY IRON

Filed Dec. 21, 1948



INVENTOR.
Gertrude T. Gross
BY
Brown, Wigmore & Mosley
ATTORNEYS


IDEAS

In Search of The Better Mousetrap

Ruth Ann Nyblod

Ruth Ann Nyblod

Ruth Ann Nybiod is the Administrator for Project XL, the U.S. Patent and Trademark Office's (PTO) educational outreach program designed to encourage the development of inventive thinking and problem-solving skills among America's youth. In this capacity, Ms. Nyblod serves as team leader for Project XL staff, establishing and integrating the goals of Project XL into the strategic planning, human resources and public relations objectives of the PTO. Ms. Nyblod frequently lectures and conducts workshops on the importance of applied thinking skills to new technology and the value of the intellectual property systems to our Nation's economic base. She serves in an ex officio capacity on the Boards of the National Inventive Thinking Association, the Capital Inventors Society and the Edison Inventors Association. In 1990 Ms. Nyblod was awarded the Silver Medal, the U.S. Department of Commerce's second highest honor, for her outreach efforts.

As Ms. Nyblod visits with students and teachers across the country, she is asked many questions about patents, trademarks and copyrights. In this chapter, Ms. Nyblod answers the questions most frequently asked and pays tribute to a diverse parade of America's most inventive thinkers.

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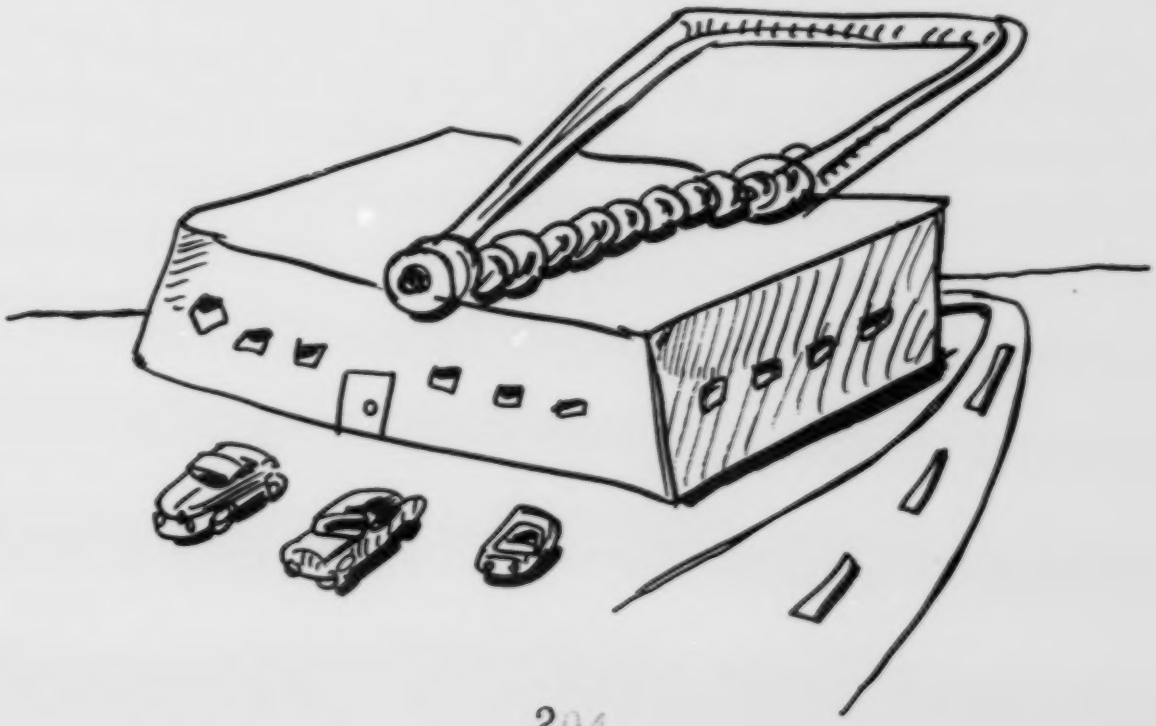
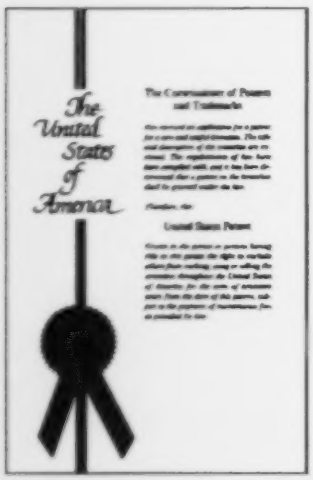


In Search of The Better Mousetrap

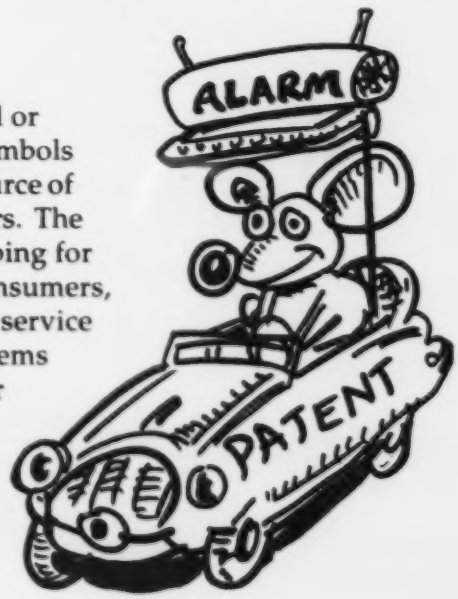
Ruth Ann Nyblod

Q. What are patents, trademarks and copyrights?

A. Patents, trademarks and copyrights are sometimes referred to as "intellectual property"—referring to products that come from the creative mind. Each are considered a piece of property, owned by the creator much like you own a car, clothing or real estate. Patents, trademark and copyrights differ in the kind of creative product they protect.



A **patent** is a grant issued by the U.S. Government (through the Patent and Trademark Office) giving an inventor the right to exclude all others from making, using or selling the invention in the United States for up to 17 years. Patents are granted to anyone who invents or discovers any new and useful or improved process, any machine manufactured article, any composition of matter, such as chemical compositions or new chemical compounds, an original ornamental design for an article of manufacture, or a distinct and new variety of plant.



® A trademark is either a word, phrase, symbol or design or combination of words, phrases, symbols or designs which identifies and distinguishes the source of the goods or services of one party from those of others. The trademark is usually what you look for when shopping for food, clothing, services or other items. We, as consumers, know what to expect in the quality of a product or service from the trademark owners and can choose those items that satisfy our purposes. Likewise, if the product or service does not meet our standards, we can hold the producer accountable in the marketplace by not purchasing their products or services. A trademark may be registered with the Patent and Trademark Office.

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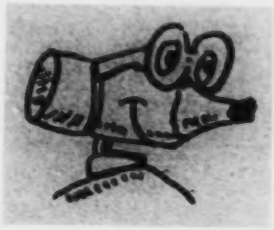
It is illegal for anyone to violate any of the rights provided to the owners of the intellectual property by patents, trademarks and copyrights.

Have students write poems or short stories about their inventing experiences. Each student's work of authorship is now "fixed" in tangible form and is immediately copyrighted. They may put a © next to their name. For example, © 1995 Kyle Allen.



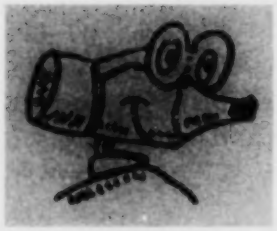
Use PLTS #'s 6-10 with this activity in order to introduce the Inventor's Principles and self-assess the students' competencies.

For a class project, ask students to write an autobiography of themselves as an inventor. Collect the autobiographies into a book of "Inventors of _____ School." *Put a © next to the name of the class as coauthors. For example, © 1995 Ms. Watson's 5th Grade Class.*

Q. What is the value and purpose of a patent and how does it benefit the Nation?

A. The constant evolution of science and technology, spurred by the monetary incentive our patent system offers to an inventor, strengthens our country's economic base. New inventions lead to new technologies, create new jobs and improve our quality of life. Under the patent system a small struggling nation has grown into the greatest industrial power on earth. It is the best, most workable method yet devised for protecting inventions, fostering industrial and technical progress and ultimately giving to the world the benefits of the individual inventor's genius.

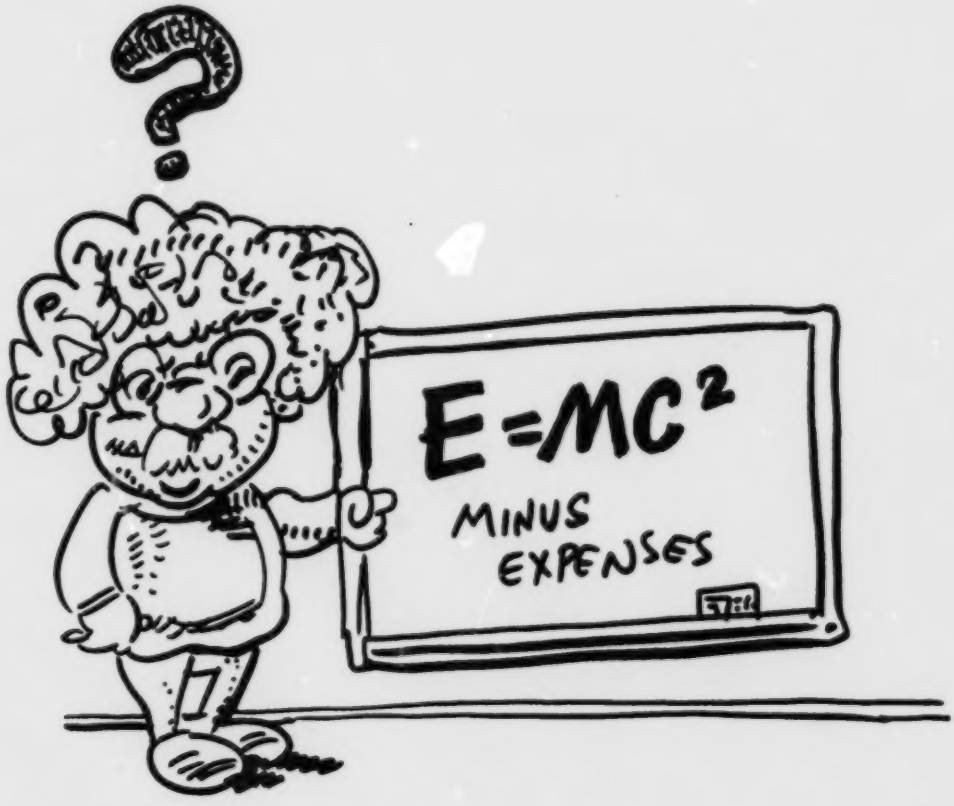
Around the year 1900, a Japanese commissioner in Washington, D.C. to study the American patent system, stated: "We have looked about us to see what nations are the greatest, so that we can be like them...We said, 'What makes the United States such a great nation?' and we investigated and found that it was patents, and we will have patents."[1]



Use PLTS #3 with this activity in order to help identify students who acquire and use information creatively.

From waking to sleeping inventions are all around you. How many inventions have you used just since you got out of bed this morning (or since lunch time)? It boggles the mind when you pause to reflect on the many, many inventions that make our lives better—and don't forget the inventions that are necessary to produce the entire product! Have students make a list of the inventions they have used today.

Now, who invented them? Inventors are people—just like you and me—who apply their knowledge and creativity to solve problems.



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Q. Why do you need a patent?

A. A patent gives an inventor the right to exclude all others from making, using or selling the invention for up to 17 years. This gives the inventor the opportunity to produce and market the invention without unfair competition and to make a profit.

Q. Does an inventor get paid when a patent is granted?

A. A patent does not guarantee monetary success by itself. An inventor gets paid by either selling the invention or by licensing or selling (assigning) the patent rights to someone else. Not all inventions are commercially successful. The invention may actually cost the inventor more money than he or she makes if a strong business and marketing plan has not been developed prior to applying for a patent.

Look around your classroom or your home and notice the patent numbers on the various products. Make a classroom thematic display related to the various patents. For example, toys always make great displays. Include MONOPOLY, SLINKY, a basketball, ETCH-A-SKETCH, etc. with a copy of their patents and soon students and adults alike will be amazed to learn that toys are indeed inventions.[2]

Treat your students to a "Munch a Bunch of Patents and Trademarks" day. Fill a basket with a bounty of patented edible delights such as apples (plant patents), FIG NEWTON cookies (utility patent for the process of making the wrapped cookie) and Pepperidge Farm GOLDFISH crackers (the fish shape is a registered trademark).[2]

For a more elaborate display, perhaps as a school or district-wide project, create a "Patent Manor" as the staff at the Patent and Trademark Depository Library of the Free Library of Philadelphia did for the Bicentennial celebration of the first U.S. patent in 1990. It was a specially built "dollhouse" which was filled with nearly 100 miniatures, most representing patents. They held a "guess the patent" contest with several people guessing correctly that the mouse (being chased by a cat) represented the patent granted to Harvard University for a genetically altered mouse.[2]

Note: Patent copies may be ordered by number from the U.S. Patent and Trademark Office, Washington, D.C. 20231. Include a $3.00 check or money order for payable to the Commissioner of Patents and Trademarks for each copy. You may also get patent copies from your nearest Patent and Trademark Depository Library for the cost of copying (see list of PTDLs at the end of this chapter.

Q. Do patents cost a lot of money?

A. The cost can be very high for some people although fees for the patent application, issue and maintenance fees and other possible related fees are reduced by 50 percent when the applicant is a small business or individual inventor. You can expect to pay a minimum of about $3,200 over the life of your patent. In addition, the Patent and Trademark Office recommends that if you do decide to apply for a patent you seek the counsel of a patent attorney or agent whose fees must also be considered in the overall cost of a patent. The high cost of a patient is a major reason why it is so

important to do market research and have a business plan. This plan is used to determine if there is reasonable expectation of cost recovery plus a profit from the sale of your invention or the licensing or selling of your patent rights.

Q. Do you need a patent to sell an invention?

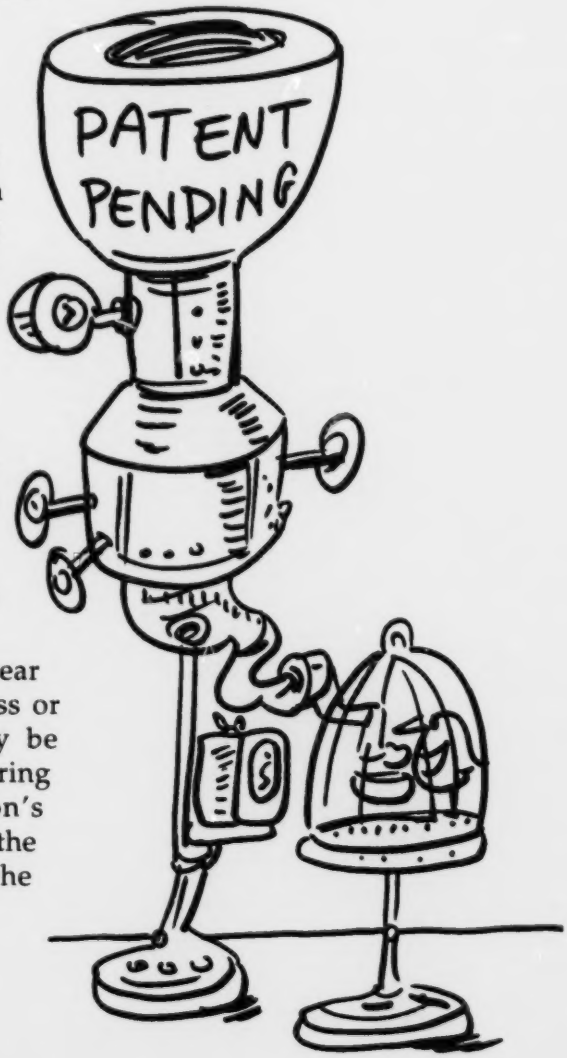
A. No, you have the right to make, use and sell you own invention. The patent gives you the right to exclude others from doing so without your permission.

Q. What would happen if you didn't have a patent?

A. In some cases, you could keep your invention a secret like the Coca-Cola Company keeps the formula for Coke a secret. This is called a **trade secret**. Otherwise, without a patent you run a risk of someone else copying your invention with no rewards to you as the inventor.

Q. How old do you have to be to get a patent?

A. There are no age restrictions on applying for a patent, but only the true inventor is entitled to a patent. The youngest person to obtain a patent so far is a four-year-old girl from Houston, Texas for an aid for grasping round knobs (Pat. #5,231,733, August 1993).



Q. What was the first patent?

A. The first U.S. patent was granted in 1790 to Samuel Hopkins for "making pot and pearl ashes"—a cleaning formula used in soapmaking.

Q. Can you renew a patent after 17 years?

A. Patents may be extended past the 17 year term only by a special act of Congress or certain pharmaceutical patents may be extended to make up the time lost during the Food and Drug Administration's approval process. After expiration of the term, the patentee loses rights to the invention.

Q. Can you remove a patent from a product?

A. An inventor probably wouldn't want to lose patent rights on a product. However, a patent may be lost if determined to be invalid by the Commissioner of Patents and Trademarks. For example, as a result of a re-examination proceeding or if the patentee fails to pay the required maintenance fees the patent may be lost.

Q. How can you be sure no one will steal your patent?

A. You can! If you think someone has infringed your patent rights, then you can sue that person or company in court.

Q. How do you know the people who work in the patent office are trustworthy for the job?

A. Each employee at the Patent and Trademark Office takes an oath of office to uphold the laws of the United States. In addition, employees of the Patent and Trademark Office are prohibited from applying for patents themselves. There has never been a case where an employee has abused his or her knowledge of information contained in a patent application.

Q. What happens if two people have the same idea and both apply for patents?

A. This happens sometimes. When the Patent and Trademark Office receives two patent applications for almost identical inventions, the cases go into an **interference proceeding**. The Board of Patent Interferences then determines the first inventor who thus may be entitled to a patent based on the information provided by the inventors. This is why it is so important for inventors to keep good records.

Q. Can food and clothing be patented?

A. Yes. A patent may be obtained for any new, useful, unobvious invention. A patent cannot be obtained on the laws of nature, physical phenomena and abstract ideas; a new mineral or a new plant found in the wild; inventions useful solely in the utilization of special nuclear material or atomic energy for weapons; a machine that is not useful; methods of doing business; printed matter; human beings; or the mere substitution of one material for another or changes in size to a previously known useful invention.

Q. How can I find out if my invention has or hasn't been invented by someone else? Can you tell me if my invention has been patented yet?

A. Inventors make a search of patents already granted to be sure that someone else has not already patented their idea. They may hire someone to do it for them or may do this themselves, at the Public Search Room of the Patent and Trademark Office in Arlington, Virginia or at one of the 78 Patent and Trademark Depository Libraries across the country. (See listing of depository libraries at the end of this chapter.)

Q. Is there only one Patent and Trademark Office in the USA?

A. Yes, there is only one, and it is located in Arlington, Virginia.

Q. How many people work at the Patent and Trademark Office?

A. It currently takes about 5,000 employees to do the job that the first patent board—Thomas Jefferson, Henry Knox, and Edmond Randolph—did 200 years ago.

Q. How long does the patent process usually take?

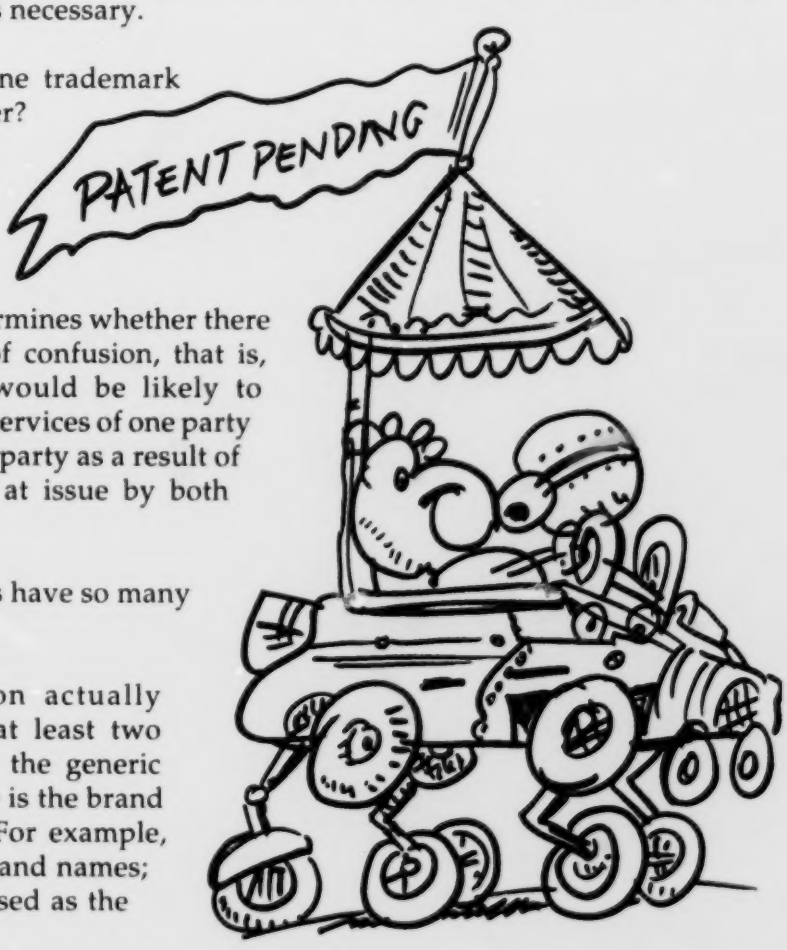
A. At this time it takes about 19 months.

Q. Are there certain qualifications that you need for a good patent application?

A. There are specific requirements for all patent applications. An application must include a specification, including a description and claim(s); an oath or declaration identifying the applicant(s) believing to be the original inventor(s); a drawing or drawings when necessary and the filing fee. Prior to 1870, a model of the invention was required as well. Today, the Commissioner of Patents and Trademarks will determine if a model is necessary.

Q. How different does one trademark have to be from another?

A. To determine whether there is a conflict between two marks, the Patent and Trademark Office determines whether there would be likelihood of confusion, that is, whether consumers would be likely to associate the goods or services of one party with those of the other party as a result of the use of the marks at issue by both parties.



Q. Why do some products have so many names?

A. Naming an invention actually involves developing at least two names. One name is the generic name. The other name is the brand name or trademark. For example, PEPSI and Coke are brand names; "cola" or "soda" are used as the

generic or product names. BIG MAC and WHOPPER are brand names; "hamburger" is the generic or product name. NIKE and REEBOK are brand names; "sneaker" or "athletic shoe" are generic or product names.

If the product or process is new and unfamiliar to potential customers, then inventors have to give them something to call the invention. If only a brand name or trademark is given to consumers to use when asking for an invention, then that name will become, from the customer's point of view, the generic or product name. For example, "Escalator" was once a brand name or trademark for the product known as a "moving stairway." "Cellophane" was once a brand name or trademark for the product known as "plastic food wrap." "Thermos" was once a brand name or trademark for "vacuum-seal bottles" for holding liquids.

In these cases, customers who bought or used these inventions were not taught the difference between the trademark and the product name. They began to use the trademarks as if they were the only names for the products and the inventors lost their trademarks.

Let's go window shopping! Ask students (when they are out shopping with their parents or taken as a class) to identify and make a list of both brand names or trademarks and the generic or product names that go with them.

There is no sure-fire way to develop good trademarks. Sometimes it takes a while for a trademark to catch on and the fact that the invention is desirable is what eventually makes the trademark for the invention well-known. In other cases, when the invention may be pretty good, but not great, a really catchy trademark can make the invention successful. An inventor's job is never completed... It Just Keeps on Going and Going, like the ENERGIZER bunny!

Int. Cl.: 9

Prior U.S. Cl.: 21

United States Patent and Trademark Office **Reg. No. 1,821,026**
Registered Feb. 15, 1994

TRADEMARK
PRINCIPAL REGISTER

DURANAME CORPORTION (DELAWARE CORPORATION)
BERKSHIRE INDUSTRIAL PARK
BETHEL, CT 06801

FOR: ELECTROCHEMICAL CELLS AND BATTERIES, IN CLASS 9 (U.S. CL. 21).
FIRST USE 0-0-1974; IN COMMERCE 0-0-1974.

THE STIPPLING IN THE DRAWING IS FOR SHADING PURPOSES ONLY.

THE MARK CONSISTS OF A RABBIT WITH A DRUM.

SER. NO. 74-124,602, FILED 12-19-1990.

RUSS HERMAN, EXAMINING ATTORNEY

References

1.) U.S. Department of Commerce, Patent and Trademark Office, *The Story of the U.S. Patent and Trademark Office*, (Washington, D.C., August 1988).

2.) Betsy Lowther, Patent and Trademark Depository Library, Philadelphia Free Library, "Displays Grab Attention," *NITA Newsletter*, October 1992; Vol. 4. No. 1, 1-4.

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29. Fort Lauderdale, FL - Broward County Main Library
30. Grand Forks, ND - Chester Fritz Library, University of North Dakota
31. Honolulu, HI - Hawaii State Public Library System
32. Houston, TX - The Fondren Library, Rice University
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PTDLP

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PATENT AND TRADEMARK OFFICE
PATENT AND TRADEMARK DEPOSITORY LIBRARY PROGRAM

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The following libraries, designated as Patent and Trademark Depository Libraries (PTDLs), receive current issues of U.S. Patents and maintain collections of earlier-issued patents as well as trademarks published for opposition. The scope of these patent and trademark collections varies from library to library, ranging from patents and trademarks of only recent years to all or most of the patents issued since 1790 and trademarks published since 1872.

These patent and trademark collections, which are organized in number sequence, are available for use by the public free of charge. Each of the PTDLs in addition, offers supplemental reference publications of the U.S. Patent Classification System, including the *Manual of Classification, Index to the U.S. Patent Classification*, and *Classification Definitions*, and provides technical staff assistance in using such publications in gaining effective access to information contained in patents and trademarks. CASSIS (Classification And Search Support Information System) and other CD-ROM products for searching patent and trademark information are available at all PTDLs. Facilities for making paper copies of patents and trademarks from either microfilm or paper collections are generally provided for a fee.

Since there are variations in the scope of patent and trademark collections among the PTDLs and in their hours of service to the public, anyone contemplating use of these collections at a particular library is urged to contact that library, in advance, about its collections and hours in order to avert possible inconvenience.

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A PATENT, TRADEMARK, AND COPYRIGHT PRIMER

On March 6, 1646, Joseph Jenkes received the first mechanical patent in North America. Issued by the General Court of Massachusetts, it protected his mill for manufacturing scythes. That was the prelude to the U.S. patent system which has helped give birth to major industries that have transformed the way we live.

On April 10, 1790, President George Washington signed the bill which laid the foundations of the modern American patent system. Since that time, the U.S. Patent and Trademark Office has recorded and protected the electric lamp of Thomas Edison, the telephone of Alexander Graham Bell, the flying machine of the Wright Brothers, and the inventions of hundreds of thousands of other inventors.

The patent system has protected inventors by giving them an opportunity to profit from their labors, and it has benefited society by systematically recording new inventions and releasing them to the public after the inventors' limited rights have expired.

The U.S. Patent and Trademark Office is one of the most unusual branches of the U.S. Government. Its examining staff of over 1,800 is trained in all branches of science and examines thoroughly every application to determine whether a patent may be granted—a task, in these days, involving the most exhaustive research. Not only must the examiners search United States and foreign patents to learn if a similar patent has been issued, but they must study scientific books and publications to discover whether the idea has ever been described. Previous publications, invention or use prevents a patent being issued.

In addition to issuing patents, the Patent and Trademark Office has, since 1870, been in charge of registering trademarks, the business community's most valuable asset. More than 1,400,000 trademarks have been issued.

In its earlier days, the Patent and Trademark Office had on various occasions the responsibility for administering copyright matters, a task that since 1870 has been administered by the Library of Congress; collecting and publishing agricultural information; and even collecting meteorological data. For some years, it was the custodian not only of the famous old Patent Office models—the delight of every visitor to Washington for many years—but of the Declaration of Independence, and other historical documents and relics.

By publishing and distributing copies of every U.S. patent, the Patent and Trademark Office has made available to the public the world's greatest scientific and mechanical library.

Patents in Brief

A patent is a grant issued by the U.S. Government giving inventors the right to exclude all others from making, using, or selling their inventions within the United States, its territories, and possessions.

There are three kinds of patents: (1) *Utility patents*, granted to the inventor or discoverer of any new and useful process, machine, manufacture, composition of matter, or any new and useful improvement thereof; (2) *plant patents*, granted on any distinct and new variety of asexually reproduced plant; and (3) *design patents*, granted on any new, original, and ornamental design for an article of manufacture.

Utility and plant patents are effective for 17 years from the date issued, subject to the payment of maintenance fees; design patents are effective for 14 years. Patents may be extended only by special act of Congress, except for some pharmaceutical patents whose terms may be extended to make up for time lost due to Government-required testing.

If you plan to file an application, you or your representative should make a search of patents previously granted to make sure that your idea has not already been patented. You may do this at the Public Search Room of the Patent and Trademark Office, Crystal Plaza Building No. 3, 2021 Jefferson Davis Highway, Arlington, Virginia. Hours are 8:00 a.m. to 8:00 p.m., Monday through Friday except holidays. More limited searches may be made at Patent and Trademark Depository Libraries located throughout the country.

The Patent and Trademark Office strongly advises you to consult a patent attorney before attempting to file an application. Names of patent attorneys and agents may be obtained from the classified telephone directories in major cities, or from a directory published by the Government Printing Office.

The basic fee for filing an application for patent ranges from $145 to $710, dependent upon the type of patent application being filed and whether or not the applicant is entitled to status as a small entity (independent inventor, small business concern, or non-profit organization). Issue fees range from $205 to $1,170. Maintenance fees are due at 3 1/2, 7 1/2, and 11 1/2 years from the date the patent is granted.

Applications are assigned to examiners who are experts in various fields of technology. The invention must be new, useful, and unobvious to those in that particular field of study. This procedure normally takes about 18 months.

Disclosure Document Program

Under its Disclosure Document Program, the Patent and Trademark Office accepts and preserves for a two-year period papers disclosing an invention pending the filing of an application for patent. This disclosure is accepted as evidence of the dates of conception of the invention, but provides no patent protection nor should it be considered a "grace period" during which the inventor can wait to file a patent application without possible loss of benefits. A fee of $10 is charged for this service.

Trademarks in Brief

A trademark (or brand name or logo) is a word, name, symbol, design, combination of word and design or slogan used by a manufacturer or merchant to identify its goods or services and distinguish them from those manufactured or sold by others. When it is used for services, it can be called a service mark.

Trademark rights come from using the mark, and marks are protected under common law from the time they are first used. While there is no requirement to do so, owners of marks who have used them or have a bona fide intention to use them in federally regulated commerce may register them with the Patent and Trademark Office. This provides the owners with certain procedural and legal advantages. For "intent-to-use" applications, actual use of the mark in commerce is a prerequisite to the ultimate issuance of a registration.

Many trademark owners use a TM (trademark) or SM (service mark) symbol with their mark to indicate that they are claiming rights in it. The ® symbol may only be used if the Patent and Trademark Office issues a Federal registration. To register a mark, the owner must file an application consisting of a written statement in which the owner indicates among other things the goods or services in connection with which the mark is used and the date of first use of the mark in commerce; a drawing of the mark; five specimens showing the mark as it is actually used (labels, tags, packaging, etc.); and the required filling fee of $245 per class.

Each application is reviewed by an examining attorney to determine if the mark is eligible for registration and is compared with other marks to determine if it is likely to cause confusion with those already registered. If a proposed mark passes the examination, it is then published in the *Official Gazette* of the Patent and

Trademark Office. Those who believe they will be damaged by registration of the mark then have an opportunity to oppose registration. If no opposition is filed, a registration certificate is issued or a notice of allowance is issued to the applicant in an "intent-to-use" application. Within six months after the issuance of the notice of allowance, the applicant must file specimens evidencing use of the mark in commerce, a fee of $100, and a verified statement that the mark is in use in commerce before a registration certificate is issued. The registration may be renewed every 10 years as long as the registrant is still using the mark.

Note: Filing fees mentioned above represent only the minimum required for a patent or trademark application. Additional fees may be due during the prosecution of an application. Fees are current as of April 1994. Fee increases, when necessary, usually take effect on October 1 of any given year. For a complete list of fees or further information, write to the U.S. Patent and Trademark Office, Public Service Center, Washington, DC 20231, or call (703) 308-HELP.

Copyrights in Brief

On May 31, 1790, Congress used the power given it in Article 1 § 8 of the Constitution to "promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries" and enacted the first Federal Copyright Act. The seeds of copyright protection were sown in Gutenberg's development of the printing press that ultimately led to the first printed copyright statute, the English Statute of Anne. Both the printing press and the concept of copyright protection followed the colonists to the new world. The state legislatures of twelve of the first states passed copyright laws before Congress enacted the first Federal law. Noah Webster, the compiler of both the first American speller and an early dictionary, played a major role in getting both the state laws and the first Federal statute enacted. He traveled to each legislature and described the authors' plight and their need for copyright protection. Authors have continued to guard the rights granted by the Constitution and to ensure that new technologies permitting copying do not erode these rights.

What is copyright and when does copyright protection arise? Federal copyright legislation gives an author certain exclusive rights for a limited time: the right to reproduce the copyrighted work, to prepare derivative works, to distribute copies or phonorecords, to perform the work publicly, and to display the work publicly. Congress attempts to create a balance between the rights given to authors and the legitimate needs for society. There are some limitations or exemptions that permit society to make specific uses of copyrighted works.

Copyright subsists in an original work of authorship from the time the work is first created or fixed in any tangible medium of expression, now known or later developed, from which that work can be perceived, reproduced, or otherwise communicated. A work is put in a tangible form, for example, when a literary work is typed or written or a piece of music captured on tape.

Copyright covers the expression of ideas and not the idea itself. Thus, copyright does not cover "any idea, procedure, process, system, method of operation, concept, principle, or discovery..." It does not, for example, protect blank checks, standardized material, titles, or government works.

What does copyright protection mean for an author? Copyright means that no one may appropriate the copyright owner's exclusive right to reproduce, distribute, perform, or display a work without permission from the author unless the right has been transferred to the user or the person who authorizes or licenses this particular use, or an exemption covers the use in question.

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What works does copyright protect? The first law protected maps, charts, and books for a basic term of 14 years; since 1790 the copyright law has evolved to include musical works, dramatic works, photographs, paintings and other works of art, motion pictures, and sound recordings.

Literary works: Copyright protects literary works of all types from novels such as *Gone with the Wind* or *The Catcher in the Rye*, to textbooks and other fact-based accounts, including newspapers. Although copyright covers the expression in nonfiction works, it does not cover the facts themselves. They are uncopyrightable and can be freely used by anyone. Copyright in literary works also covers printed speeches such as Martin Luther King, Jr.'s famous "I have a dream" speech. Today, even computer programs are protected as literary works.

Musical works: Copyright covers all kinds of music from the songs performed on the radio to the music in television commercials and MTV.

Dramatic works: Copyright covers every kind of permanently fixed dramatic work from senior plays such as *Our Town* performed by high schools, to such current Broadway blockbusters as *Phantom of the Opera*, *M. Butterfly*, or the latest Neil Simon offering. It covers those plays written especially for the theatre like Arthur Miller's classic *Death of a Salesman* and also those based on other popular works like the adaptation of Kafka's short story *Metamorphosis*.

Pantomimes and choreographic works: Copyright protects dance sequences in stage shows like *Chorus Line* or *Cats* if they are in tangible form.

Pictorial, graphic, and sculptural works: Works created by sculptors, photographers, painters, and other graphic artists are protected by copyright. The works covered include not only paintings, photographs, and sculptures, but also advertisements, the artwork on game boards, and the artwork on fabrics or textiles.

Motion pictures and other audiovisual works: Classics like *Gone with the Wind* or the latest Steven Spielberg or Woody Allen film are protectible, as are television programs and videogames, including the once very popular Pac Man and the currently popular Nintendo games.

Sound recordings: The copyright law was amended in 1971 to include sound recordings. Copyright now protects the latest recording of your favorite artist in any format—disk (be it 45 or 33, or compact disk), tape, or cassette. The copyright authorship protected in a sound recording is twofold: it covers the contribution of both the performer and the record producer responsible for the recording.

How long is a work protected? As noted earlier, the 1790 act provided a 14 year term. Mark Twain was one of the authors who persuaded Congress that the term should be longer. In 1909 the term was extended to protect authors for a 28 year term plus a possibility of 28 more years if the author renewed his or her claim in a timely fashion. Then in 1976 the term was extended again to its current length: the life of the author plus 50 years. Special rules apply to works created by employees as part of their jobs such as motion pictures and anonymous or pseudonymous works.

When the term of protection expires on a particular work, it may be used freely by anyone.

Where is the work protected? A work copyrighted in the United States is protected here as well as in all of the other countries with whom we have copyright relations by our membership in the two multilateral copyright treaties—the Universal Copyright Convention and the Berne Convention for the Protection of Literary and Artistic Works, by presidential proclamation, or bilateral relations. The United States has copyright relations with over 100 countries.

The filing fee for each application is $20. (Note: The Copyright Office has the authority to adjust fees at 5-year intervals. The next adjustment is due in 1996.)

Additional information concerning copyrights may be obtained from the Library of Congress, Information Section, LM-455 Copyright Office, Washington, DC 20559. Telephone (202) 707-2100.

PTO BBS

Patent and Trademark Office Bulletin Board System

The United States Patent and Trademark Office's electronic bulletin board (PTO BBS) is now available. Patent and Trademark Depository Libraries are invited to make use of the PTO BBS and to inform the public about it.

The PTO BBS provides limited patent searching, viewing, and downloading of the files described below, as well as electronic mail between users of the system. Please note that the BBS sections and files described below are under development and subject to change. A few of the files have not yet been completed but will be available in the near future.

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Contains news items, press releases from the PTO and the Department of Commerce, bulletins specific to the PTO BBS and its users, and reports such as *Top Patenting Companies* which shows the ten companies issued the most patents for a particular year.

(2) **Services and Products**
Describes what's available from the PTO's Patent Copy Sales and in the PTO's Public Search Room. Contains a list of products available from the PTO's Office of Electronic Information Products and Services, including the Technology Assessment and Forecast Program, and from the Office of Data Base Administration. Contains a description of PKware's PKZIP software used to compress and decompress files on the PTO BBS.

(3) **Patent Information**
Contains the current week's *Official Gazette* notices for patents, a list of recently expired patents, the most recent PTO fee schedule for patents, and the bibliographic data of the current month's issue of patents.

(4) **Files to Download**
Contains the previous weeks' issue of patents, the previous weeks' *Official Gazette* notices, and miscellaneous compressed files such as the *Attorney Roster*, master file of expired patents, and the *Manual of Patent Examining Procedure*. A shareware version of PKZIP, required for decompressing the other files, is also available for downloading from this section.

(5) **Utilities**
Provides access to user-changeable parameters, including passwords and registration information.

(6) **Directory Information**
Contains telephone listings for the Patent and Trademark Office, the Department of Commerce, Patent and Trademark Depository Libraries (PTDLs), PTDLs where the public have access to the PTO's Automated Patent System, as well as the PTO BBS table of contents.

(7) **Trademark Information**
Contains *Official Gazette* notices for trademarks.

(8) **Help**
Contains the BBS User's Guide and additional help menus.

(9) **Electronic Mail**
Communicate electronically with the Sysop or other PTO BBS users.

The PTO BBS may be accessed using a computer with a modem and telecommunications software either directly (six roll-over telephone lines) or through FedWorld (two roll-over telephone lines), for a total of eight simultaneous users. FedWorld itself may be accessed directly or via the Internet. Configure your modem and software as follows: any speed from 1200 to 9600 baud, 8 character bits, no parity, 1 start/stop bit. To access the PTO BBS directly, dial 703-305-8950. To access the PTO BBS system via FedWorld, dial 703-321-8020 and select DD116 from the FedWorld Menu. To access FedWorld via Internet, telnet to fedworld.gov or use the address 192.239.92.201. The PTO BBS is open 24 hours a day, seven days a week, with the following exceptions: every Tuesday from 7:00 a.m. to 12:00 a.m. for data loading, and as announced on the BBS for maintenance. The PTO BBS does not allow uploads of any kind. To make comments, ask questions, or report problems, send an e-mail message to Sysop.

U.S. Trademark Association

A Trademark
is the name of a product.
It is how we choose our favorite
foods, games and other products
that we buy.

Match these famous trademarks
with the common term for the products they describe.

TRADEMARKS	COMMON TERMS
1. Apple®	A. toothpaste
2. Crest®	B. board game
3. Barbie®	C. computer
4. Kleenex®	D. photocopiers
5. Reebok®	E. cereal
6. Levi's®	F. athletic footwear
7. Count Chocula®	G. tissue
8. Doublemint®	H. jeans
9. Xerox®	I. fashion doll
10. Monopoly®	J. chewing gum

All of the trademarks shown above are registered in the United States Patent and Trademark Office. They are frequently used with the symbol ® to show that they are federally registered trademarks.

Now turn the page over and try your luck at side 2!

Find these twenty famous food, drink and restaurant trademarks

BIG MAC®
BORDEN®
CARNATION®
COKE®
CREMORA®
FRITO-LAY®
HERSHEY®
JELL-O®
KENTUCKY FRIED CHICKEN®
LIFE SAVERS®
LIPTON®
MCDONALD'S®
NESTLE®
OREO®
PEPSI®
TACO BELL®
TOTAL®
TRIX®
WHOPPER®
WISE®

F	R	I	T	O	L	A	Y	O	S	C	T	F	C
Q	K	A	C	R	E	M	O	R	A	D	R	R	A
O	E	D	R	E	A	L	M	R	Q	X	I	T	R
N	N	E	N	H	E	R	S	H	E	Y	X	T	N
E	T	U	R	Y	T	U	R	K	M	O	L	E	A
S	U	L	O	N	J	E	N	E	S	B	A	S	T
T	C	K	T	D	O	A	P	C	X	N	O	I	I
L	K	N	O	R	R	O	O	O	B	I	N	S	O
E	Y	L	T	E	E	L	A	K	L	Z	A	D	N
O	F	R	A	A	O	R	P	E	P	S	I	J	T
N	R	K	L	H	O	I	N	E	M	A	R	E	M
S	I	H	A	L	M	E	C	L	E	W	A	L	A
N	E	N	E	D	T	A	C	O	B	E	L	L	X
W	D	I	L	L	I	N	R	S	O	N	K	O	S
M	C	D	O	N	A	L	D	S	A	R	D	J	E
O	H	N	E	S	W	H	O	P	P	E	R	R	P
L	I	F	E	S	A	V	E	R	S	B	R	C	L
Z	C	A	B	I	G	M	A	C	A	O	E	R	E
D	K	I	G	E	L	I	S	T	X	R	I	C	O
X	E	L	I	P	T	O	N	D	I	D	O	I	U
U	N	O	M	D	O	R	S	S	M	E	P	E	Y
W	I	S	E	N	O	T	S	O	A	N	M	A	E

The United States Trademark Association is the largest international membership organization that supports and advances trademarks as essential to commerce throughout the world.

USTA is now the International Trademark Association
1133 Avenue of the Americas
New York, NY 10036-6712

Test your Trademark I. Q.

How many of these trademarks can you identify?
For the answers see reverse side.

A.

B.

C.

D.

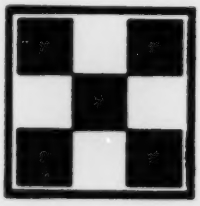
E.

F.

G.

H.

I.

J. 

K.

L.

M.

N.

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P.

Q.

R.

S.

T.

Answers

MARK

(A) CBS

(B) White Rock Psyche

(C) McDonald's Arch symbol

(D) Seagram's 7 Crown

(E) Green Giant

(F) Safeway

(G) Morton International Umbrella Girl

(H) Maxwell House Div. of General Foods, Cup and Drop symbol

(I) Hallmark Crown symbol

(J) Checkerboard Square of Ralston Purina Co.

(K) Bell symbol of American Telephone & Telegraph

(L) Lawry's

(M) Cotton Bud symbol of Cotton Incorporated

(N) Gerber Baby

(O) Singer Company

(P) Quaker Oats

(Q) Mister Donut

(R) Circle "W" of Westinghouse Electric Corp.

(S) Frigidaire Crown symbol

(T) Woolmark of The Wool Bureau Inc.

International Trademark Association, 1133 Avenue of the Americas
New York, NY 10036-6712; phone (212) 768-9887

Character Trademarks

WANTED
A Few Good Trademarks
Have you seen these characters ?

1.

2.

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WANTED
A Few Good Trademarks
Have you seen these characters ?

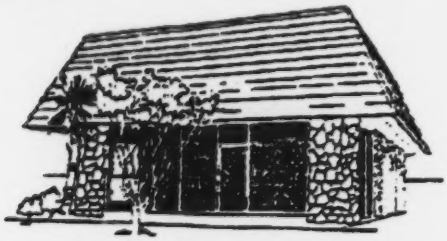
1. "Trix" owned by General Mills registered 1960.
2. "Sam" owned by Los Angeles Olympic Organizing Committee registered 1980.
3. "Charlie the Tuna" owned by Star-Kist Foods, Inc. registered 1977.
4. "Poppin' Fresh" owned by Pillsbury Company registered 1971.
5. "Elsie the Cow" owned by The Borden Company registered 1945.
6. "Noid" owned by Domino's Pizza, Inc. registered 1988.
7. "Mr. Zip" owned by the United States Postal Service registered 1963.
8. "Indian Maid" owned by Land O' Lakes, Inc. registered 1971.
9. "Miss Sunbeam" owned by Quality Bakers of America registered 1942.
10. "Mr. Clean" owned by Proctor & Gamble Company registered 1957.
11. "Toucan Sam" owned by Kellogg Company registered 1964.
12. "Mac Tonight" owned by McDonald's Corporation registered 1986.
13. "Sun-Maid" owned by Sun-Maid Growers of California registered 1915.
14. "California Raisin" owned by California Raisin Advisory Board registered 1986.
15. "Gerber Baby" owned by Gerber Products Company registered 1934.

The design of a building can be a registered trademark because you can tell what goods or services are offered there. See how many buildings you can recognize. (The answers are below, upside down).

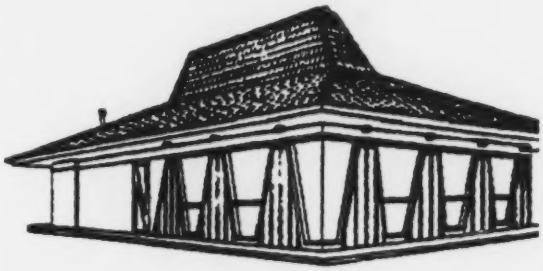
1)

2)

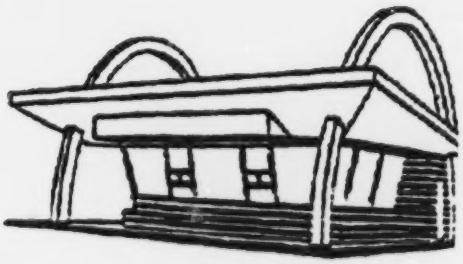
3)



4)

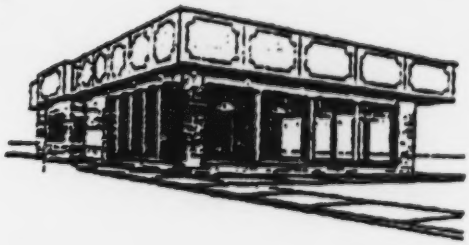


5)

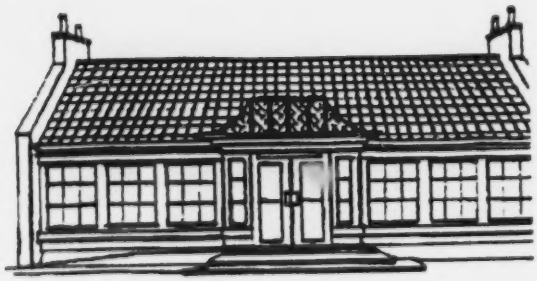


6)

7)



8)



1. Fotomat (Registration number 0911388) 2. Kentucky Fried Chicken (Reg.No. 1599822) 3. Popeye's (Reg.No. 1107609) 4. Pizza Hut (Reg.No. 0852458) 5. McDonald's (old)(Reg.No. 0764837) 6. McDonald's (new)(Reg.No. 1045615) 7. Wendy's (Reg.No. 1120227) 8. Toddle House (Reg.No. 1565178).

America's Progress of Science and Useful Arts...

The U.S. intellectual property systems are the epitome of our democratic government. They offer the same opportunity and the same hope of reward to every individual. For over 200 years, the inherent rights of inventors and authors have been--and will continue to be--recognized, valued, and protected by our Government as prescribed for in the U.S. Constitution.

As you go through your daily routines, reflect upon the many inventions and artistic or literary works and especially the inventors and artists who created them to make our lives richer. Use these examples as a daily reminder of the progress of technology and the arts and of the inventive and creative talents to be nurtured in your classroom.

JANUARY

1	2 Willis Carrier patented a "method for air conditioning in 1906	3	4	5	6 Pat. #1,522,176 granted in 1925 to George Washington Carver (African-American) of Tuskegee, Alabama, for cosmetics	7 Pat. #1,049,667 granted in 1913 to William Meriam Burton for the manufacture of gasoline
8	9	10	11	12	13	14
15 Pat. #31,128 granted to E. G. Otis in 1861 for "improvement in hoisting apparatus" (safety elevator)	16 Actress Lillian Russell received a patent for a trunk-dresser in 1912	17	18 © Lerner and Lowe's musical "My Fair Lady" was registered in 1957	19	20	21
22	23 © The movie "Casablanca" was registered in 1943	24	25 © The movie "On Golden Pond" was registered in 1982	26	27 Pat. #223,898 granted in 1880 to Thomas A. Edison of Menlo Park, NJ, for "an electric lamp for giving light by incandescence"	28 Pat. #135,245 granted in 1873 to French chemist Louis Pasteur for a process of brewing beer and ale
29 Pat. #533,244 granted in 1895 to Charles P. Steinmetz of Schenectady, NY, for "system of distribution by alternating current" (A/C power)	30	31 © Michael Jackson's "Thriller" was registered in 1983	*Congress shall have power... to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.* Article 1, Section 8, U.S. Constitution			

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FEBRUARY

1 Pat. #588 granted in 1838 to John Ericsson for a propeller Ericsson designed and built the Civil War ironclad *Monitor* for the U.S. Navy. The propeller is still the main form of marine propulsion.	2 Pat. #3,168,172 granted in 1965 to Alfonso Alvarez (Hispanic) of Upper Montclair, NJ, for "dual-vent windows"	3 © The first episode of the TV program "Dragnet" was registered in 1952	4 Pat. #2,230,654 granted in 1941 to Roy Plunkett for "tetrafluoroethylene polymers" (TEFLON)	5 In an 1859 lecture at Springfield, IL, Abraham Lincoln pays tribute to the patent system: "The patent system added the fuel of interest to the fire of genius."	6 © Frank Capra's "It's a Wonderful Life" was registered in 1947	7
8	9 Pat. #1,127,789 granted to Elijah McCoy (African-American) in 1915 for "tread for tires"	10 Sidney Jacoby was granted a patent in 1976 for a combination smoke and heat detector alarm	11 Thomas A. Edison's birthday (1847-1931). Edison received 1,093 patents during his lifetime.	12	13	14
15 ® A rabbit with a drum is registered in 1994 as a trademark of the Duraname Corporation of Bethel, CT, for electrochemical cells and batteries	16	17	18 Auguste Bartholdi was granted Design Pat. #11,023 in 1879 for "Liberty Enlightening the World" (the Statue of Liberty)	19 Pat. #200,521 granted to Thomas A. Edison in 1878 for a "phonograph or speaking machine"	20	21
22	23 © The song "As Time Goes By" from the movie "Casablanca" was registered in 1943	24 ® Victor Talking Machine Company 1925	25	26	27 Felix Hoffman was granted a patent in 1900 for "acetyl salicylic acid (aspirin)	28 Pat. #2,736,880 was granted to Jay W. Forrester in 1956 for "multicoordinated digital information storage device" (random access memory for digital computers)
29 230	Black History Month... 231 Dr. Charles R. Drew, a Washington, D.C. native, excelled in academics and sports during his graduate studies at Amherst College, Massachusetts. He was also an honor student at McGill University Medical School in Montreal where he specialized in physiological anatomy. It was during his work at Columbia University in New York City whre he made his discoveries relating to the preservation of blood plasma in what are currently referred to as blood banks. His discovery of blood plasma is used extensively in modern day medicine to save lives.					

MARCH

1 Pat. #1,370,316 granted to Harry Houdini in 1921 for a "diver's suit," enabling the wearer "to quickly divest himself of the suit while being submerged and to safely escape and reach the surface of the water."	2	3 Thomas Jennings (African-American) received a patent in 1921 for "dry scouring of cloths." Jennings may have been the first African-American inventor to receive a U.S. patent.	4	5 © The movie "Airport" was registered in 1970	6	7 Pat. #174,465 granted to Alexander Graham Bell in 1876 for "telegraphy (the telephone)
8 ® University of Notre Dame 1983	9	10	11	12	13	14 Eli Whitney was granted a patent for the cotton gin in 1794
15 SCHWINN CYCLING AND RECYCLING ® Schwinn Cycling & Fitness, Inc. 1994	16	17	18	19	20 Pat. #274,207 granted to Jan E. Matzeliger (African-American) in 1883 for a "lasting device"	21
22	23	24	25 Pat. #3,873,284 granted in 1975 to Cayetano Aguas (Hispanic) of Seal Beach, CA, for a "smoke stack washer"	26 ® U.S. Olympic Cmte. 1974	27	28
29 232	30	31	Women's History Month Stephanie Kwolek, one of DuPont's leading chemists, discovered the "miracle fiber," KEVLAR, which has five times the strength of steel by weight. Uses for KEVLAR are seemingly endless, including ropes and cables for oil drilling rigs, canoe hulls, boat sails, automobile bodies and ties, and military and motorcycle helmets. Many Viet Nam veterans and police officers are alive today because of protection provided by bullet-proof vests made from KEVLAR. Because of its strength and lightness, KEVLAR was chosen as the material for the Gossamer Albatross, a pedal airplane flown across the English Channel. (Source: "Her Works Praise Her, Inventions by Women," Minnesota Historical Society Exhibit)				

APRIL

1	2 Pat. #400,665 granted to Charles M. Hall of Oberlin, OH, in 1889 for the "manufacture of aluminum"	3 Pat. #3,724,070 granted to Francis W. Dorion, Jr. of Hingham, MA, in 1973 for a "dual razor blade assembly" (Gillette TRAC II razor blade)	4 Pat. #4,081,909 granted in 1978 to Francisco G. Garcia (Hispanic) for "orthodontic pliers"	5	6 Pat. #88,711 granted to Isaac Hodgson of Indianapolis, IN, in 1869 for the "roller skate"	7
8	9	10 President George Washington signed into law the first patent act in 1790	11	12 Pat. #4,736,866 granted to Harvard University in 1988 for a "transgenic non-human mammal" (the mouse designed to radically improve the process of detecting cancer-producing substances developed by Drs. Philip Leder and Timothy Stewart)	13 Pat. #88,929 granted to George Westinghouse, Jr., of Schenectady, NY, in 1869 for an "improvement in steam-power brake devices"	14 Pat. #3,129,001 granted to Paul Winchell (famous ventriloquist) in 1964 for an "inverted novelty mask"
15	16	17	18	19	20	21
22	23	24	25 Pat. #4,085,745 granted in 1978 to Santiago S. Alenaris (Hispanic) for an "elastic support for the veins of the foot"	26 ® World Cup USA 1994	27	28
29 234	30	Did you know... In 1844, the Commissioner of Patents, Henry L. Ellsworth, stated in his annuall report for 1843, while commenting on important inventions which have been mde, that "the advancement of the arts, from year to year, taxes our credulity and seems to presage the arrival of that period when human improvement must end." This rhetorical flourish is probably the origin of the unfounded story of the Patent Office official who resigned because everything had been invented.				

MAY

1 Pat. #382,280 granted to Nikola Tesla of New York in 1888 for the "electrical transmission of power" (induction-type electric motor)	2	3	4	5 In 1802, Mary Kies of Killingly, CT, was the first woman to obtain a U.S. patent. Her invention relates to "weaving straw with silk or thread."	6	7
8	9	10 TINY TOON ® Warner Bros. Inc. 1994	11	12 ® Reebok International, Ltd. 1987	13	14
15	16	17	18	19	20	21
22 Pat. #831,393 granted to Wilbur and Orville Wright of Dayton, OH, in 1906 for "new and useful improvements in flying machines"	23	24	25 Pat. #2,442,141 granted to Andrew J. Moyer of Peoria, IL, in 1948 for a "method for production of penicillin"	26	27	28
29 236	30 First Federal Copyright bill enacted in 1790	31	Asian-Pacific American Heritage Month Dr. An Wang was born in Shanghai, China, in 1920. He received a Bachelor of Science Degree from Chaio Tung University in 1940. In 1945, he immigrated to the Unitd States and attended Harvard University where he earned both a Master of Science and a Ph.D. Dr. Wang founded Wang Laboratories, Inc., in 1951. In 1955, he became a naturalized U.S. citizen as well as Chairman of the Board and Chief Executive Officer of Wang Laboratories. Dr. Wang is responsible for the original development of the basic components and systems of digital computing machines. His inventions have revolutionized today's information processing industry.			

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JUNE

1	2 KRAFT ® Kraft General Foods, Inc 1992	3	4 Pat. #3,091,888 granted in 1963 to six-year-old Robert W. Patch for a "toy truck"	5	6	7
8	9 Pat. #2,641,545 granted in 1953 to John H. Kraft of Chicago, IL, for the "manufacture of soft surface cured cheese"	10	11	12	13 Pat. #2,351,004 granted to Marvin Camras for "magnetic recording"	14 Pat. #232 granted to August Gotthliff of New York, NY, for "improvement in the method of protecting timber" (pressure treated lumber)
15 Pat. #3,633 granted to Charles Goodyear of New York, NY, in 1844 for "improvement in the manner of preparing fabric of india rubber" (vulcanization of rubber)	16 In 1980, the U.S. Supreme Court ruled that a living microorganism is patentable. The decision (*Diamond v. Chakrabarty*) makes life forms patentable for the first time, except for those covered under the plant patent laws.	17	18	19	20 Pat. #1,647 granted to Samuel F. B. Morse of New York, NY, for "telegraph signs" (the telegraph)	21 Cyrus H. McCormick of Virginia patented the "reaper" in 1834
22	23 ® Colgate-Palmolive Company 1992	24	25 Pat. #1,718,305 granted to G. L. Pierce in 1929 for the "basket ball"	26	27	28 239
29 238	30 Pat. #3,139,248 granted in 1964 to Alberta Alvarez-Calderon (Hispanic) for a "variable geometry system and aparatus for aircraft"	Did you know... The SLINKY, or "toy and process of use" was patented by Richard T. James in 1947. His invention was the result of a failed attempt to produce an antivibration device for ship instruments. Having built a spring that James hoped would instantaneously counterbalance wave motion on a ship, he accidentally knocked one off a shelf and saw it literally crawl, coil by coil, to a lower shelf, onto a stack of books, down to the tabletop, and finally come to rest, upright, on the floor. James' wife, Betty, saw its potential as a toy and named it SLINKY. Source: Science and Technology Desk Reference: Carnegie Library of Pittsburgh, Science and Technology Department; p.78.				

JULY

1	2	3	4	5	6 Pat. #764,166 granted in 1904 to Albert Conzales (Hispanic) for a "railway switch"	7 ® Marriott Corporation 1992
8	9 Pat. #3,392,261 granted to Frederick R. Schollhammer in 1968 for a "portable beam generator" (hand-held laser ray gun)	10	11	12	13 Pat. #3,194,237 granted to Benjamin A. Rubin in 1965 for "bifurcated vaccination needle" which helped eradicate deadly smallpox.	14 Pat. #322,177 granted in 1885 to Sarah E. Goode for a folding cabinet bed. She was the first African-American woman to obtain a U.S. patent.
15	16	17	18	19	20 ® Professional Golfers' Association of America 1993	21
22	23	24 ® Honda Motor Co., Ltd. 1990	25	26	27 Pat. #3,971,926 granted to Gerald S. Gau (Hispanic) of Houston, TX, for a "simulator for an oil well circulating system"	28
29	30 © The MONOPOLY board game was registered in the Copyright Office in 1933	31 The first U.S. patent was issued in 1790 to Samuel Hopkins for "making pot and pearl ashes," a cleaning formula then used in soapmaking.	Did you know... There is much more to a patent collection than its obvious patent/invention connection. No other collection offers so much to so many and satisfies such a variety of information needs. Comprising over 5,000,000 patents, the U.S. patent file is the most complete--and compact--collection of technological information in the world. About 8 out of 10 patents contain information not published elsewhere. This priceless repository of world knowledge is freely accessible to the public in the Patent and Trademark Office search facilities and in the Patent and Trademark Depository Libraries located around the country.			

AUGUST

1	2 Pat. #766,768 granted to Michael J. Owens of Toledo, OH, in 1904 for a "glass shaping machine." The immense production of glass bottles, jars, etc., owes its inception to this invention.	3	4	5	6 Micro Machines ® Lewis Galoob Toys, Inc. 1991	7
8	9 Pat. #608,845 granted to Rudolf Diesel of Paris, France, in 1898 for an "internal combustion engine" (Diesel engine)	10	11	12	13	14
15	16 Pat. #2,478,967 granted to Leonard Greene of Mineola, NY, in 1949 for an "airplane stall warning device"	17	18 Plant Pat. #1 issued in 1949 to Henry F. Bosenberg of New Brunswick, NJ, for "a climbing rose... characterized by its everblooming habit"	19	20	21 Pat. #388,116 granted in 1888 to William Seward Burroughs for a calculating machine
22	23	24	25 British burn Washington in 1814	26	27	28
29 Pat. #504,038 granted to Whitcomb L. Judson in 1893 for "slide fastener" (zipper) 242	30 Pat. #610,040 granted to Henry Ford of Detroit, MI, in 1898 for "new and useful improvements in carburetors..." Ford was granted a total of 161 U.S. patents.	31 General Mills ® General Mills, Inc. 1993	Did you know... As the British were burning Washington, D.C. in 1814, Dr. William Thornton, Superintendent of Patents, pleaded with the British Commander not to "burn what would be useful to all mankind." During the following year, Congress met in the Patent Office building while the Capitol was being restored.			

SEPTEMBER

1	2	3	4	5	6	7 Pat. #2,448,908 granted in 1948 to Louis W. Parker for a television receiver. Parker's "intercarrier sound system" is used in all television receivers in the world. Without it, television receivers would not work as well and would be more costly.
8 ® DLM, Inc. 1992	9	10	11	12	13 Pat. #107,304 granted to Daniel C. Stillson in 1870 for a "wrench" (improved monkey wrench)	14 ® Twentieth Century Fox Film Corp. 1993
15 ® Matchbox Toys, Ltd. 1992	16	17	18	19	20 [illegible] 2,130,948 granted to Wallace H. Carothers in 1938 for "synthetic fiber" (nylon)	21
22	23	24	25	26	27 Pat. #4,050,459 granted in 1977 to Anacleto Montero Sanchez (Hispanic) for a "hypodermic syringe"	28
29 244	30	Hispanic Heritage Month--September 15 through October 15 Trademarks are the business community's most valuable asset. The importance of trademarks in building industrial recognition and good will cannot be overestimated. Strong trademark protection can be as important as a strong patent portfolio to a successful business. 				Prior U.S. Cl.: 21 United States Patent Office Reg. No. 992,392 Registered Sept. 3, 1974 TRADEMARK Principal Register MINIFUS [illegible] 24

OCTOBER

1 © The first episode of Rod Serling's "Twilight Zone" was registered in 1959	2 Pat. #1,242,065 granted in 1917 to Elmer Ambrose Sperry for a "gyroscopic compass." Sperry's ideas are used today to stabilize space vehicles.	3 Pat. #2,524,035 granted in 1950 to John Bardeen and Walter H. Brattain for "three-electrode circuit element utilizing semi-conductive materials" (the transistor)	4	5	6 Pat. #2,297,691 granted in 1942 to Chester F. Carlson for "electro-photography" (xerox copying)	7 Pat. #3,909,854 granted in 1975 to Ysidro M. Martinez (Hispanic) for a "knee implant prosthesis"
8	9 Pat. #3,057,356 granted in 1962 to Wilson Greatbatch of New York for a "medical cardiac pacemaker"	10 Pat. #1,005,186 granted in 1911 to Henry Ford of Detroit, MI, for a "transmission mechanism"	11 Pat. #2,956,114 granted in 1960 to Charles P. Ginsburg for a "videotape recorder." The new machine was first used by CBS TV in 1956.	12 ® Nike, Inc. 1993	13	14 Henry Blair (African-American) of Glen Ross, MD, received a patent in 1835 for an improved corn planter
15 ® Pizza Hut, Inc. 1991	16	17	18	19	20	21
22	23	24	25	26	27 ® Nintendo of America, Inc. of Redmond, WA, registered the configuration of its hand-held game machine in 1992	28
29 246	30	31 Pat. #3,003,667 granted in 1961 to Edward Aguado (Hispanic) of St. Louis, MO, for an "airway for artificial respiration"	Americans with Disabilities Month 247 Ysidro M. Martinez invented a below-the-knee prosthesis that avoids some of the problems associated with conventional artificial limbs. Martinez, himself an amputee, used a theoretical approach in his design. He does not attempt to replicate the natural limb. His design has no articulated joints in the ankle or foot, which is seen by the inventor as causing poor gait. His prosthesis has a high center of mass and is light in weight to facilitate acceleration and deceleration and reduce friction. The foot is considerably shorter to control acceleration forces, reducing the friction and pressure.			

NOVEMBER

1	2	3	4	5	6	7
8	9 ® Burger King Corp. 1982	10 Pat. #2,301,710 granted to Charles Drew (African-American) in 1942 for an "apparatus for preserving blood." Drew later became the first director of the American Red Cross Blood Bank.	11 Pat. #1,781,541 granted in 1930 to Albert Einstein, then of Berlin, Germany, and his coinventor for "an apparatus for producing refrigeration"	12	13	14
15 Pat. #775,134 granted in 1904 to King C. Gillette for a "razor" (safety razor)	16	17 Pat. #463,569 granted to Emile Berliner in 1891 for a carbon microphone transmitter (combined telegraph and telephone). He sold his patent to the fledgling Bell Telephone Company paving the way for it to become one of the world's largest corporations.	18	19 Pat. #687,098 granted in 1901 to Granville T. Woods (African-American) from Columbus, OH, for a third rail to operate electrified railways. Woods held more than 60 patents related to the railroad industry.	20 Pat. #1,475,024 granted in 1923 to Garrett Morgan (African-American) for his traffic signal, the forerunner of the modern stop light.	21
22	23 Pat. #594,059 granted to Andrew Jackson Beard (African-American) for a railway car coupler	24 Pat. #157,124 granted in 1874 to Joseph F. Glidden of DeKalb, IL, for an "improvement in wire fences" (barbed wire)	25 Pat. #3,922,522 granted in 1975 to Robert S. Ledleyfor "diagnostic X-ray systems" (CAT Scan)	26	27	28
29	30	Native American Heritage Month Phillip J. Stevens (Oglala Sioux), graduated from the University of California at Los Angeles with Bachelor and Master of Science degrees in engineering. Stevens dircted the Minuteman III Weapon System at TRW, Inc., and founded Ultrasystems, Inc., a $1,000,000-a-year high-technology business enterprise. He holds several patents for innovative concepts in weaponry. Stevens is the former director of the United Indian Development Association and was awarded the U.S. Department of the Interior's highest civilian award--the Conservation Service Award--for outstanding support to American Indians. He also received numerous other awards for leadership and excellence.					

DECEMBER

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1 © "Scrabble" is registered in the Copyright Office in 1948	2 Pat. #3,482,037 granted in 1969 to Marie V.B. Brown et al (African-American) for a "home security system"	3	4 Pat. #4,974,982 granted in 1990 to Thomas W. Nielson of Sandy, UT for a "keyring pocket pen"	5	6 © A new arrangement of "Happy Birthday to You" by Mildren J. Hill was registered in 1935	7 Pat. #942,809 granted in 1909 to Leo H. Baekeland of Yonkers, NY, for "new and useful improvements in condensation products and method of making same" (resulted in Bakelite and the modern plastics industry)
8 Tootsie Roll ® Tootsie Roll Industries, Inc. 1987	9	10 ® Columbia Pictures Industries, Inc. 1985	11 ® Shell Oil Company, 1990	12	13	14
15 Pat. #3,161,861 granted in 1964 to Kenneth H. Olsen (developer of the minicomputer) for "magnetic core memory." Olsen and MIT colleague, Harlan Anderson, formed the Digital Equipment Corp in 1957 and moved into the FORTUNE 500 in 1974.	16 © The movie "A Tale of Two Cities" was registered in 1935	17 The one-millionth U.S. trademark is registered in 1974 to Cumberland Packing Corporation of Brooklyn, NY, for a simple G clef and staff design used on "Sweet'n Low"	18	19 © The movie "Lawrence of Arabia" was registered in 1962	20	21 © Walt Disney's "Snow White and the Seven Dwarfs" was registered in 1937
22 ® Nike, Inc. 1992	23	24	25	26	27 Pat. #3,294,148 granted in 1966 to Humberto B. Alvarado (Hispanic) of Los Angeles, CA, for a "fuel feeding system for internal combustion engines	28 Plant Pat. #4,000 is granted in 1976 to James C. Mikkelsen of Ashtabula, OH, for a Poinsettia
29 ® Duke University, 1992	30 TRAC II ® The Gillette Company, 1975	31 © The movie "Gone With The Wind" was registerd in 1939	Did you know... One of the rights accorded to the owner of copyright is the right to reproduce or to authorize others to reproduce the work in copies or phonorecords. This right is subject to certain limitations, e.g., "fair use." However, the distinction between "fair use" and infringement may be unclear and not easily defined. There is no specific number of words, lines, or notes that may safely be taken without permission. The courts have regarded as fair use, "quotation of excerpts in a review or criticism for purposes of illustration or comment; quotation of short passages in a scholarly or technical work, for illustration or clarification of the author's observations; use in a parody of some of the content of the work parodied; summary of an address or article, with brief quotations, in a news report; reproduction by a library of a portion of a work to replace part of a damaged copy; reproduction by a teacher or student of a small part of a work to illustrate a lesson; reproduction of a work in legislative or judicial proceedings or reports; incidental and fortuitous reproduction, in a newsreel or broadcast, of a work located in the scene of an event being reported." The safest course is always to get permission from the copyright owner before using copyrighted material. Acknowledging the source of the copyrighted material does not substitute for obtaining permission.				

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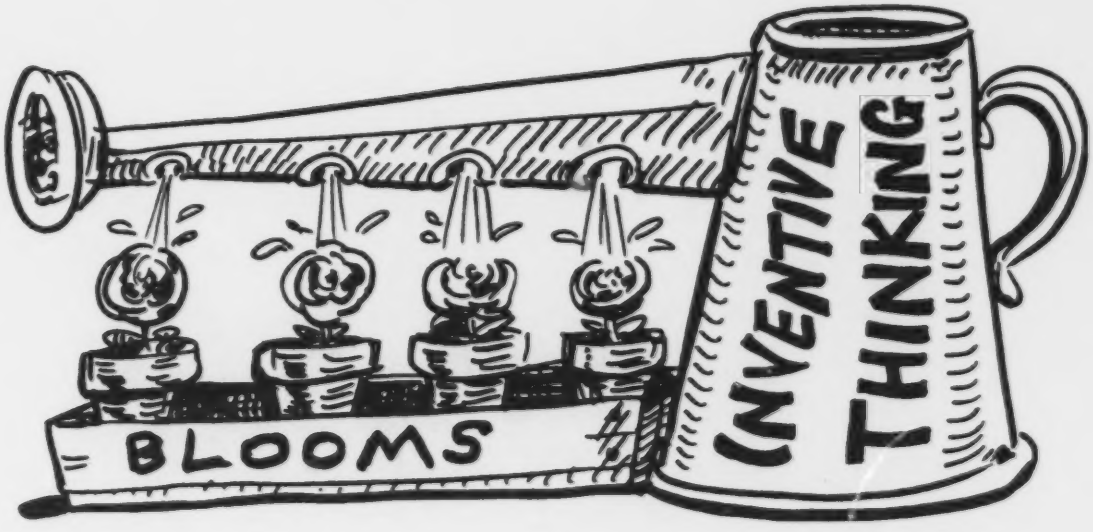
SHARING BLOOMS WITH STUDENTS

RAYNA HUMASON

Rayna Humason

Rayna Humason is a teacher of elementary school gifted / talented children in the Toledo Public Schools Horizons program. She is member of the Patent Commissioner's Roundtable, and a board member of the National Inventive Thinking Association. She is a founder, past president and member of the Toledo Association for the Promotion of Inventive Thinking. Rayna has presented student invention at many conferences and workshops since 1984.



Sharing Blooms with Students

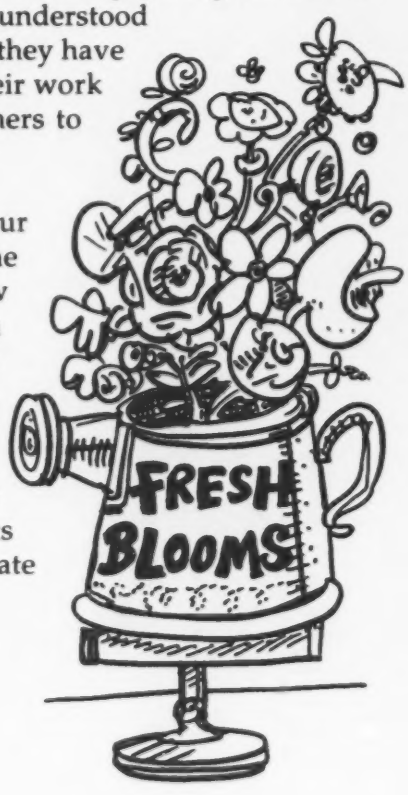
Rayna Humason

Most teachers are familar with Benjamin Bloom's "Taxonomy of Educational Objectives;" therefore, this is an attempt to help those students and teachers beginning work with creativity and inventing by associating activities with Bloom's work. You will remember that in 1948, while attending the American Psychological Association convention, Benjamin Bloom and approximately thirty others met as an informal committee to name and organize educational objectives. They wanted to make it easier for educators to talk with each other as they planned learning activities for their students. They spent time "thinking about thinking" until 1956 when Benjamin Bloom compiled the committees ideas in the *Taxonomy of educational objectives: The classification of educational goals, handbook 1; Cognitive domain.* This came to be known as Bloom's Taxonomy.

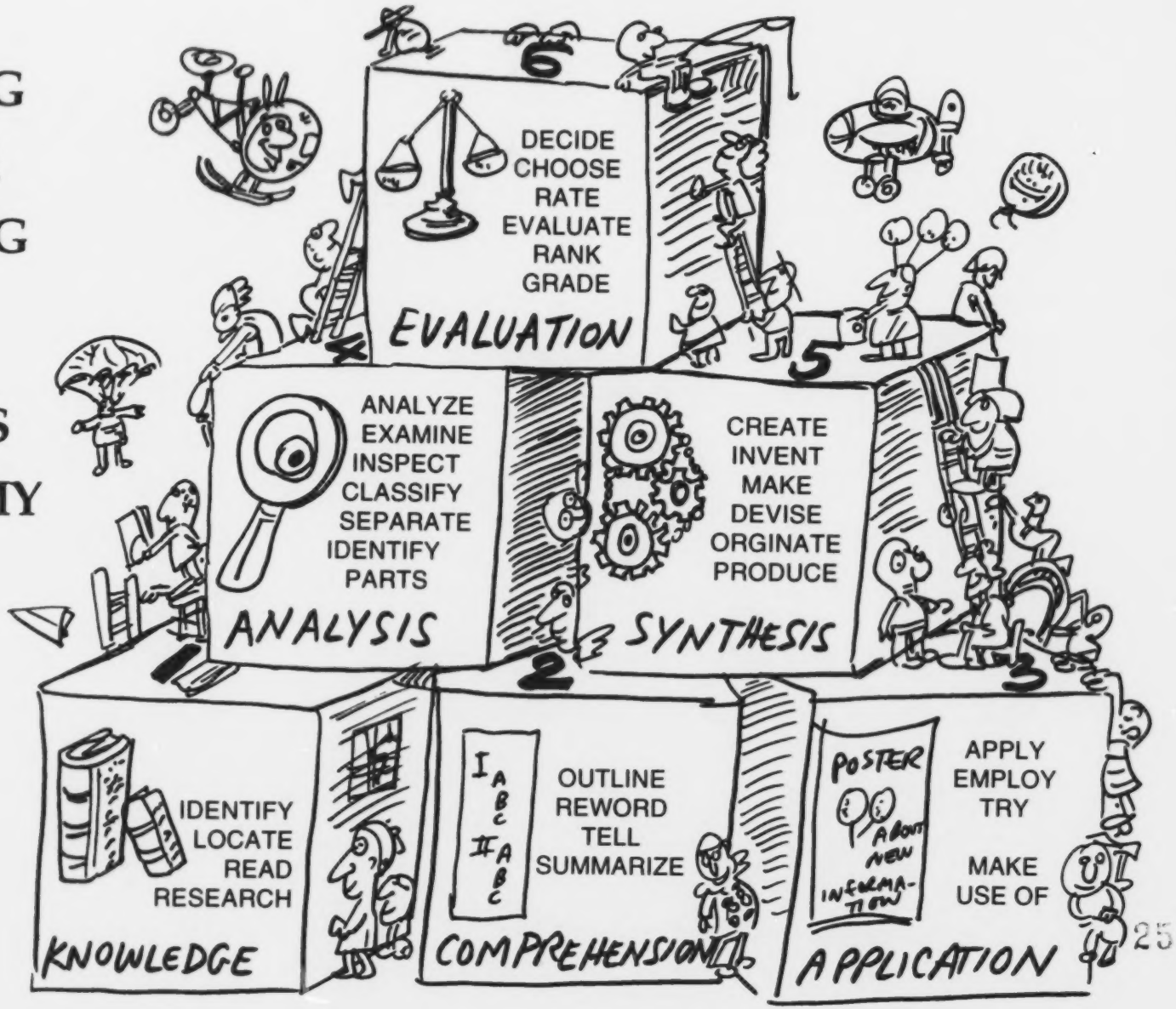
Knowledge, comprehension and application can be thought of as the foundation on which more complex or higher levels of thinking will build.

The analysis, synthesis and evaluation levels are where students spend a great deal of time while inventing. They use what they have learned and understood to find useful and original solutions to the real problems they have selected. As students become thoroughly involved in their work they often become self-directed learners, requiring teachers to become facilitators rather than directors.

Share the Bloom's cognitive taxonomy model with your students. Take time to discuss each level. Explain that the verbs show the types of behaviors used at each level. Show that students usually move through the taxonomy in sequential order from knowledge to evaluation although most class time is often spent at the knowledge, comprehension and application level because of time and curriculum constraints. While inventing, there will be a need to move back and forth between the levels. A great deal of time will be spent at the higher levels where students become independent learners who discover, invent and create new ideas and products.



BUILDING HIGHER THINKING with BLOOM'S TAXONOMY



Bloom's for Kids

Knowledge	Remember what has been read, heard, seen, experienced
Comprehension	Restate, summarize, reorder parts of information learned, make predictions using known facts
Application	Use learned information, appropriately, in a new situation
Analysis	Compare/contrast, order parts, check relationships
Synthesis	Produce a new and unique product or process
Evaluation	Make judgments based on internal or external criteria about the value of something

The following pages contain suggested activities at all levels of Bloom's Taxonomy which can be used with an invention unit.

KNOWLEDGE LEVEL
STUDENT ACTIVITIES

• COLLECT INFORMATION • **LIST PROBLEMS TO BE SOLVED**

• LEARN ABOUT AN INVENTOR'S LOG • **LEARN THE DEFINITIONS OF INVENTION, INNOVATION, DISCOVERY, SERENDIPITY** • LEARN ABOUT INVENTORS' RESPONSIBILITIES • **LEARN PARADOX AS RELATED TO INVENTORS** • LEARN ABOUT PATENT, TRADEMARK AND COPYRIGHT LAW

• **LEARN ABOUT INTELLECTUAL PROPERTY AND THE CONSTITUTION OF THE UNITED STATES** • LEARN THE CHARACTERISTICS OF A PATENTABLE INVENTION • **LEARN HOW TO INVENT** • LEARN THE THINKING SKILLS AND THEIR APPLICATIONS

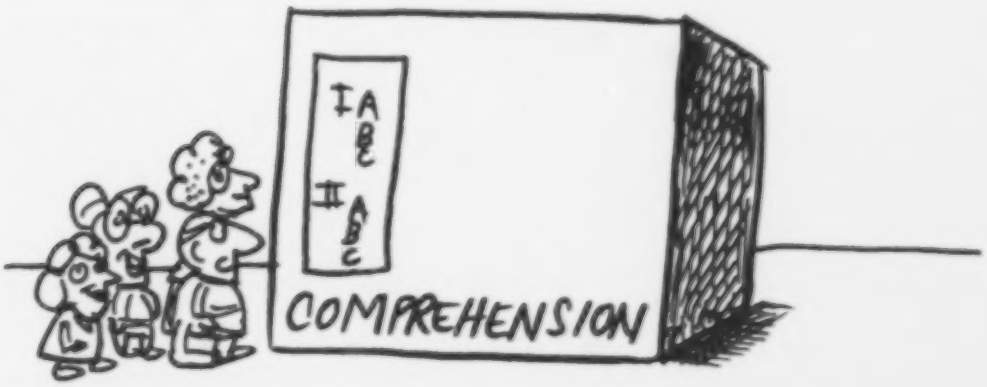
KNOWLEDGE LEVEL
TEACHER ACTIVITIES

• COMMUNICATE PROJECT PLANS, EVENTS, DATES WITH PARENTS

• **PROVIDE BOOKS, STORIES, PUZZLES, AUDIO VISUALS, BULLETIN BOARDS, HANDS-ON ACTIVITIES, GUESTS, FIELD TRIPS RELATING TO INVENTORS AND INVENTIONS** • RELATE INVENTION TO SCHOOL SUBJECT AREAS • **SHARE " MYSTERY" INVENTIONS** • EXPLAIN PATENT, TRADEMARK AND COPYRIGHT LAWS • **DEFINE A PATENTABLE INVENTION** • EXPLAIN THE USE OF AN INVENTOR'S LOG • **IF POSSIBLE, VISIT A PATENT DEPOSITORY LIBRARY** • PROVIDE INSTRUCTION AND PRACTICE WITH THE USE OF THINKING SKILLS • **HELP CHILDREN UNDERSTAND THAT FAILURE IS ACCEPTABLE** • SET UP A TIMELINE OF ERAS OF INVENTION • **DISCUSS "NECESSITY IS THE MOTHER OF INVENTION"** • TEACH THAT INVENTING IS AN ATTITUDE OF TRYING TO MAKE THINGS BETTER OR CONRIBUTING POSITIVELY TO PROGRESS

COMPREHENSION LEVEL
STUDENT ACTIVITIES

• IDENTIFY INVENTORS AND INVENTIONS • **ORDER INVENTIONS ACCORDING TO ERA AND/OR TECHNOLOGICAL COMPLEXITY** • PREDICT FUTURE CHANGES IN INVENTIONS • **SUMMARIZE INFORMATION ABOUT**

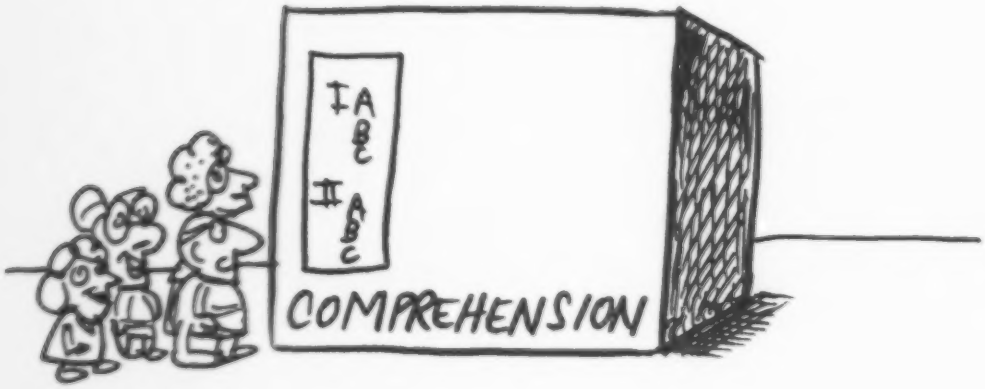


INVENTORS AND THEIR INVENTIONS • PLACE INVENTIONS AND INNOVATIONS ON TIMELINE •**UNDERSTAND THAT INVENTORS ARE PEOPLE OF ALL AGES, BOTH SEXES AND FROM ALL CULTURES** • BEGIN RECORDING INFORMATION IN INVENTOR'S LOGS • **ORGANIZE AND STORE INVENTION INFORMATION**

COMPREHENSION LEVEL
TEACHER ACTIVITIES

• QUESTION STUDENTS FOR UNDERSTANDING • **HELP STUDENTS PARAPHRASE INFORMATION** • TEACH PARADOX AS RELATED TO INVENTIONS AND INVENTORS • **PROVIDE TIME FOR COLLECTING AND ORGANIZING INVENTION MATERIALS INTO INDIVIDUAL FOLDERS**

• PROVIDE OPPORTUNITIES TO USE THINKING SKILLS



APPLICATION LEVEL
STUDENT ACTIVITIES

• CREATE A TRIBUTE TO AN INVENTOR OF THEIR CHOICE • **THE TRIBUTE MAY TAKE MANY FORMS - REPORT, POEM, VIDEO, IMAGINED DIARY, GAME, DRAMATIZATION, AUDIO TAPE PROGRAM, ETC**

• ADD INFORMATION TO A TIMELINE • **ADD INFORMATION TO THEIR INVENTOR'S LOG** • NARROW LIST OF PROBLEMS TO BE SOLVED

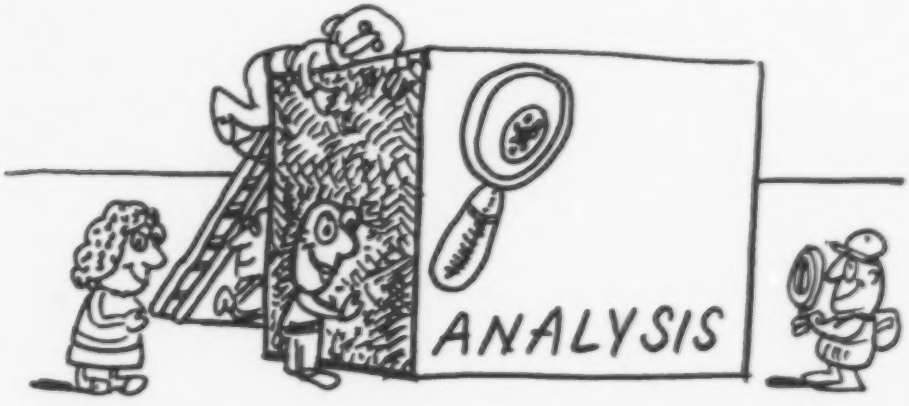
• **DESIGN AN INNOVATION OF THEIR SCHOOL DESK, CHAIR OR OTHER FAMILIAR OBJECT** • FIND AND PRESENT INFORMATION ABOUT A LOCAL INVENTOR • **CONTRIBUTE INFORMATION TO BULLETIN BOARDS, COLLECTIONS, ETC.** • SHARE A "MYSTERY" INVENTION WITH THE CLASS

APPLICATION LEVEL
TEACHER ACTIVITIES

• FACILITATE STUDENTS TO DECIDE WHAT METHOD THEY WILL USE TO PRESENT THEIR TRIBUTE TO AN INVENTOR • **CONTINUE TO PROVIDE INFORMATION RESOURCES AND MATERIALS** • SHARE PUBLIC SPEAKING TECHNIQUES AND ALLOW TIME FOR STUDENTS TO PRACTICE

ANALYSIS LEVEL
STUDENT ACTIVITIES

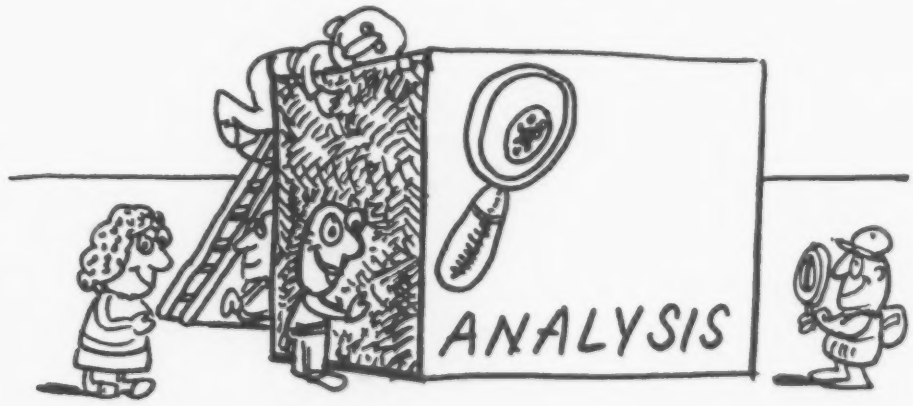
• CONSIDER THE FUNCTION OF THEIR TAKE-APART • **DRAW A DIAGRAM OF HOW THEY THINK THEIR TAKE-APART WILL LOOK INSIDE** • TAKE APART THEIR OBJECT • **RECORD WHAT THEY ACTUALLY FOUND INSIDE AND HOW THE PARTS RELATE TO THE FUNCTION OF THEIR MACHINE** • USE PROPER TOOLS • **CLASSSIFY THE PARTS OF THEIR MACHINE**



• CHOOSE A PROBLEM TO SOLVE WITH AN INVENTION • **BRAINSTORM SOLUTIONS TO THEIR SELECTED WORKABLE SOLUTION** • DECIDE WHAT MATERIALS THEY WILL NEED FOR THEIR INVENTION • **RESEARCH AND DEVELOP THEIR INVENTION** • TEST THEIR INVENTION

ANALYSIS LEVEL
TEACHER ACTIVITIES

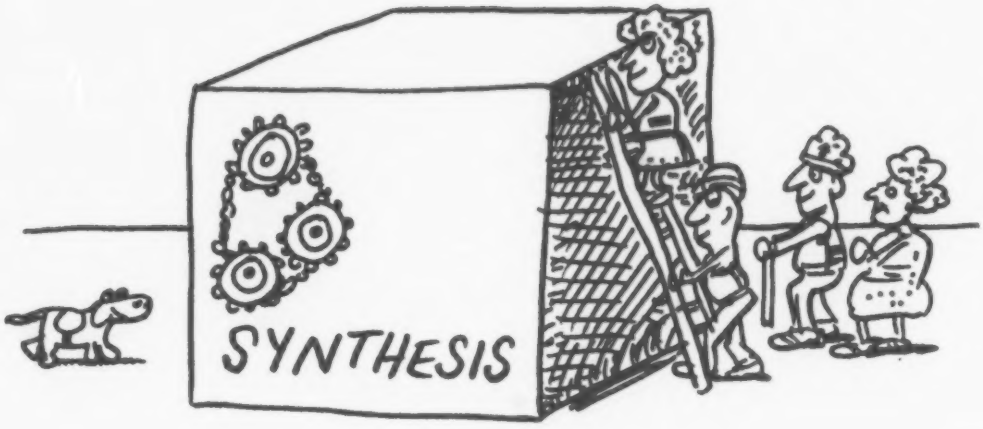
PROVIDE NONWORKING APPLIANCES FOR STUDENTS TO EXAMINE AND TAKE APART • **PROVIDE HAND TOOLS, GOGGLES AND SAFETY PROCEDURES FOR TAKE-APART ACTIVITIES** • QUESTION AND DISCUSS WHAT HAD TO BE INVENTED BEFORE THE TAKE-APARTS WERE INVENTED • **ASK STUDENTS TO PREDICT WHAT CHANGES WILL COME IN THE FUTURE FOR THEIR TAKE-APART** • PROVIDE SUPPLIES FOR RECORD KEEPING • **ENCOURAGE OBSERVATION, ANALYSIS, CLASSSIFICATION AND CREATIVE USES OF LEFT OVER PARTS** • HAVE STUDENTS MAKE RUBE GOLDBERG INVENTIONS WITH REMAINING PARTS • **USE WILLIAM'S MODEL TO DISCUSS OUTCOMES** • ENCOURAGE RISK-TAKING • **DISCUSS FAILURE AND PERSISTENCE**



SYNTHESIS LEVEL
STUDENT ACTIVITIES

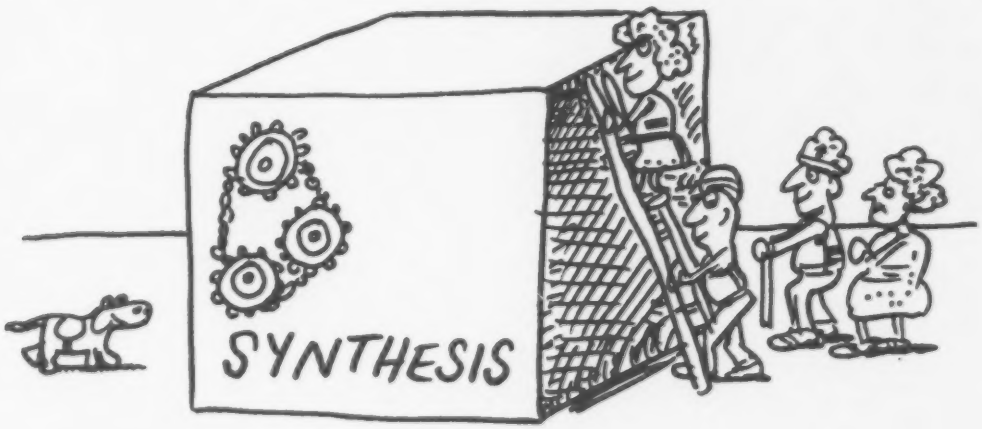
• CONSTRUCT THEIR INVENTION • **CREATE A DISPLAY, TRADEMARK,**

ADVERTISING AND PRESENTATION FOR THEIR INVENTION



SYNTHESIS LEVEL
TEACHER ACTIVITIES

• PROVIDE RESOURCES, TIME AND SPACE FOR STUDENTS • **PROVIDE A CHECKLIST OF REQUIREMENTS FOR THE SHARING OF STUDENT INVENTIONS AND TRIBUTES TO INVENTORS** • ARRANGE FOR SHARING TIME AND SPACE • **EXPLAIN THE PROCESS AND TIME INVOLVED IN STUDENT INVENTING TO THE GUESTS** • SUGGEST QUESTIONS GUESTS MIGHT ASK THE STUDENT INVENTORS • **ARRANGE FOR JUDGES IF DESIRED** • INSTRUCT JUDGES TO BE SUPPORTIVE, POSITIVE, ENCOURAGING



EVALUATION LEVEL
STUDENT ACTIVITIES

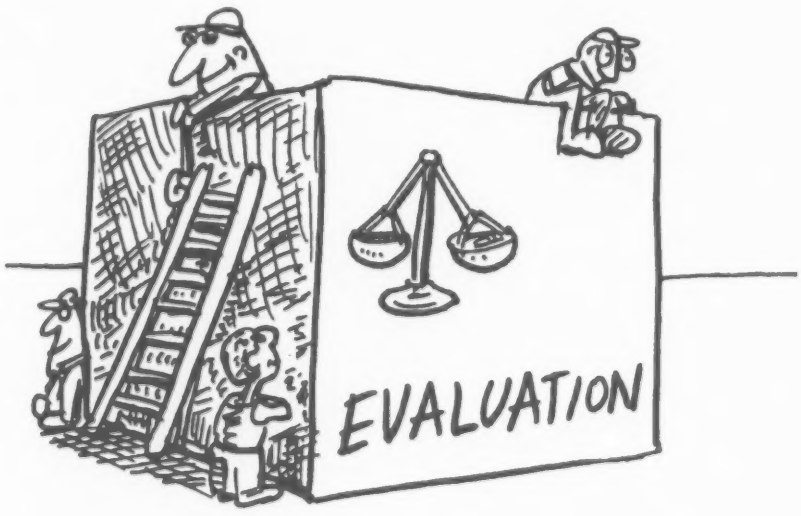
• CHECK TO SEE IF THEIR INVENTION WORKS • **CHECK TO THE BEST OF THEIR ABILITY TO SEE IF THEIR INVENTION IS ORIGINAL** • LIST THE POSITIVE ATTRIBUTES OF THEIR INVENTION • **COMPLETE CHECKLIST TO SEE IF ALL REQUIREMENTS WERE MET** • ANSWER QUESTIONS ABOUT HOW THEY SELECTED THEIR PROBLEM AND COMPLETED THEIR SOLUTION

• **EXPLAIN WHAT WAS MOST DIFFICULT ABOUT COMPLETING THEIR INVENTION** • PRESENT THEIR INVENTION TO PEERS AND GUESTS (JUDGES IF USED) • **ANSWER QUESTIONS AND RECEIVE COMMENTS ABOUT THEIR INVENTION** • WRITE ABOUT THEIR EXPERIENCES AS AN INVENTOR. TELL WHAT THEY LIKED, DISLIKED, WOULD DO DIFFERENTLY. TELL HOW SUCCESSFUL THEY FEEL THEY WERE.

EVALUATION LEVEL
TEACHER ACTIVITIES

• HELP STUDENTS COMPLETE CHECKLIST OF REQUIREMENTS FOR PRESENTATION OF INVENTIONS AND TRIBUTES • **INSTRUCT JUDGES TO BE SUPPORTIVE, ENCOURAGING, POSITIVE AND THOUGHTFUL**

• PROVIDE A SIGNATURE AND COMMENT SHEET TO BE KEPT AT EACH INVENTOR'S PRESENTATION AREA • **AT END OF SHARING TIME - CELEBRATE** • ENCOURAGE STUDENTS TO CONTINUE TO THINK LIKE INVENTORS,CONTINUALLY TRY TO IMPROVE SITUATIONS AND FIND POSITIVE SOLUTIONS TO PROBLEMS

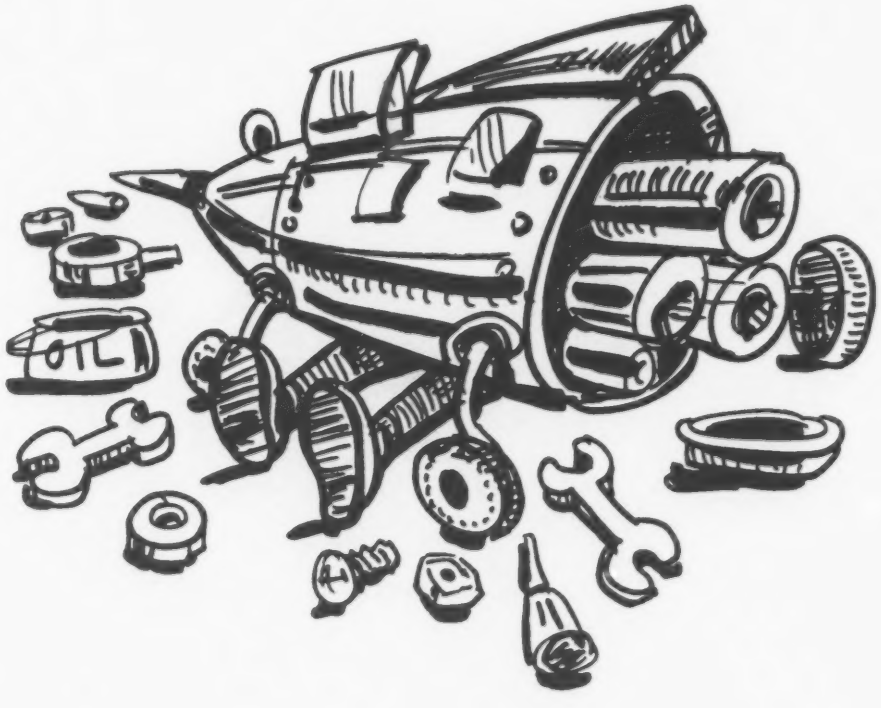


YOU TOO CAN BE A ROCKET SCIENTIST!

Dr. Harry B. Herzer, III

Dr. Harry B. Herzer, III

Harry Herzer, is an Adjunct Professor at Oklahoma State University and serves as an educational specialist with the National Aeronautics and Space Administration in Washington, DC., for the Aerospace Education Services Program. Prior to joining NASA's AESP, Dr. Herzer taught chemistry as well as general science in high school, and science education and chemistry in college. He has conducted programs and workshops for teachers and students all across the United States and Canada. Dr. Herzer has made many presentations at regional, national and international conferences. A major purpose of his efforts at NASA is to use the results of our Nation's space program by implementing and infusing them into the existing curriculum.



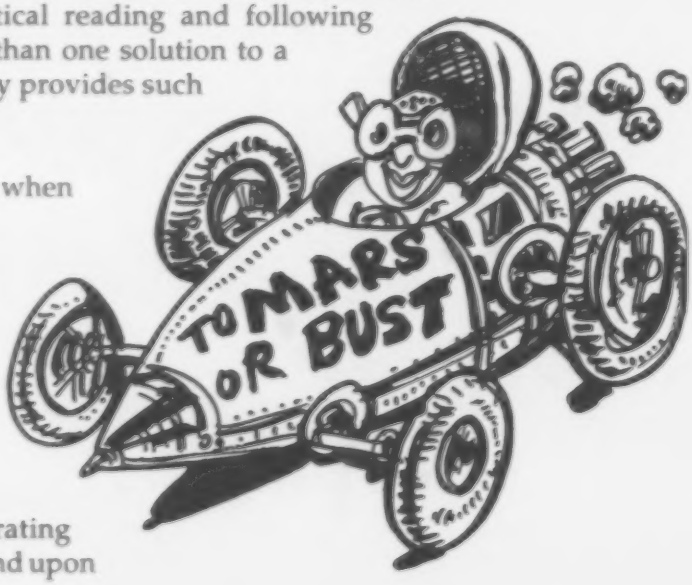
YOU TOO CAN BE A ROCKET SCIENTIST!

Dr. Harry B. Herzer, III

Model rocketry was selected as a topic for this book because it incorporates many aspects of science and mathematics as well as the aesthetics of design. Model rocketry is frequently considered an endeavor in which one merely follows a set of directions to a successful conclusion. However, it also can be used as a method to allow the students to think for themselves and build their own designs and make improvements. For those who are concerned about the hazards of rocket propellants, don't worry, the pre-packaged engines are quite safe. (The scars on Dr. Herzer's left hand were from propellant experiments at age 13 and not from Estes engines!)

Dinosaurs! Space!! Sex!!! We must get the attention of our students before any learning can begin. Hooks or grabbers are a necessary factor; dinosaurs, space and sex are guaranteed to interest most. Model rocketry provides such an outlet for both the technical and the aesthetic. The altogether-too-common phrase that "it doesn't take a rocket scientist" to accomplish a given simple task implies that a rocket scientist must be some kind of genius. For this activity, the students will find out that they too can become a rocket scientist. You as a teacher will discover that this topic can be an effective means of teaching some basic physics of electrical wiring, forces, center of gravity, logic and aerodynamics while providing many opportunities for the aesthetics of design.

Many so-called experiments require the student to follow the directions. There is a time and place for critical reading and following directions, but there may be more than one solution to a problem and usually is. This activity provides such latitude.



A philosophy of things technical...or when NOT to follow directions.

1. **Why it is a good idea to follow directions?** When performing a task that must be repeated, it is wise to follow a prescribed set of guidelines. Whether flying a space shuttle or operating a nuclear reactor, lives depend upon

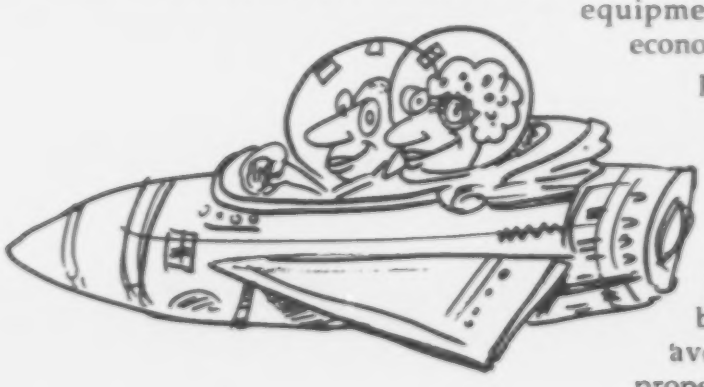
following correct procedures. If performing an analysis or a preparation (analyzing an air sample for ozone or baking cookies) and we desire consistency and reliability, then of course, follow the directions!

2. **When not to follow the directions?**
   If you want to find out "what will happen if," use an experiment. For example, if when baking cookies, one uses a lower temperature and bakes for a longer amount of time (or uses a higher temperature and bakes for a shorter amount of time) what difference does it cause? This should be a controlled experiment, so that someone else (or you) can repeat the procedure. (Here we go again, following the directions!) One must always be aware of potential hazards. If one is experimenting with rocket fuel, there is the potential for an uncontrolled reaction.

3. **Does one really learn from following the directions?**
   Probably not. One learns discipline and that is good, but one does not really learn what is going on by merely following the directions. Therefore it is important to understand what is happening either by controlled experimentation or by simulation. Then a person can more fully appreciate the need for following directions in order to accomplish a particular goal.

With this philosophy in mind, you will be given some directions for the construction of several scientific instruments or apparatus. **First** find out what the item is supposed to do, **then** read the directions. At this point you may want to vary the procedure because the materials available are not the same size or composition. Ask yourself, will this make any difference? If it does, what modifications must then be introduced?

Model rocketry is an endeavor from which many students and a great many adults derive pleasure. Model rocket kits are available from local hobby shops. The launch pads and controllers are also available. Although the commercially available systems are quite satisfactory, the cost may be prohibitive for some. A complete system will cost about thirty dollars. Model rockets provide experience in carefully following directions and there is only a little latitude available for creativity except for the aesthetics of decorations. Model rocketry can be approached from the standpoint of **problem solving** which stimulates the creative talents in the students. Designing and building the launch equipment also adds the aspect of economy in addition to providing practical experience in simple electrical circuitry. However, for safety and reliability, one should use the pre-packaged engines of the type that are readily available. There is a limit to the topics that should be included in the free-wheeling avenues of creativity! Rocket propellants are beyond the scope of



this endeavor. These rocketry activities are suitable for students from upper elementary through high school, depending upon their psychomotor skills. One doesn't need a classroom full of launch pads. One should begin with the graphite-cellulose designs, i.e. pencil and paper, from individuals. Stage a design competition, then form into groups for the construction of the winning designs.

Be a designer (or a design engineer)...

Which comes first, what the device is supposed to do or its appearance, i.e. function or form?

BUILDING YOUR OWN ROCKET

To build your own rocket it is essential to have a reliable, safe commercial engine if you are going to launch it. For safety, one should use pre-packaged engines of the type that are sold by Estes Industries in Penrose, Colorado and Quest Education in Phoenix, Arizona which are available in local hobby shops. These come in standard sizes and thrusts. Rather than experiment with rocket propellants which do present some serious hazards, we will concentrate on the efficiency of our rockets through design.

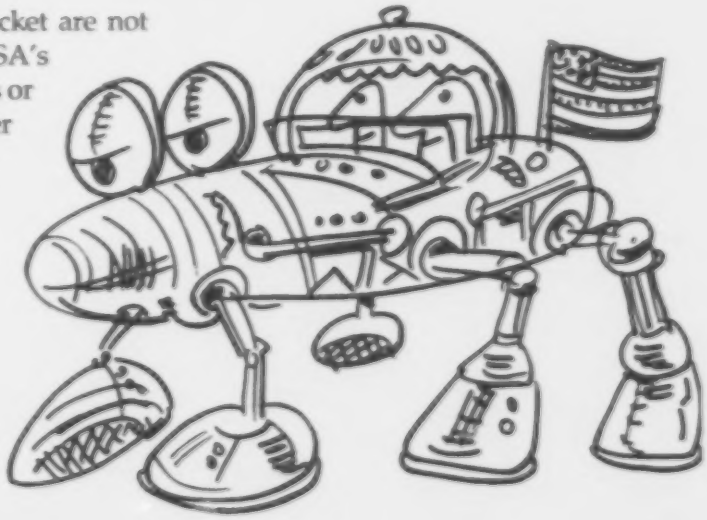
The rocket engines that are readily available come in three physical sizes. The mini engines have a diameter of 1.3 cm and length of 4.5 cm; the A, B, and C engines are all the same physical size 1.75 cm diameter and 7.0 cm length; the D engines are 2.4 cm in diameter and 7.0 cm in length. There are larger engines available, but they cost much more and are not readily available in stores.

The thrust of the engines doubles for each letter. The 1/2 A engine produces 1.25 Newton-seconds, the A engine produces 2.5 N-sec, B is 5.0 N-sec, C is 10 N-sec, the D is 20 N-sec.

WHAT ROCKETS NEED TO HAVE

The principle parts of a model rocket are not much different than one of NASA's Sounding Rockets, Ballistic Missiles or NASA's launch vehicles. They differ in size and sophistication, but the principles are the same.

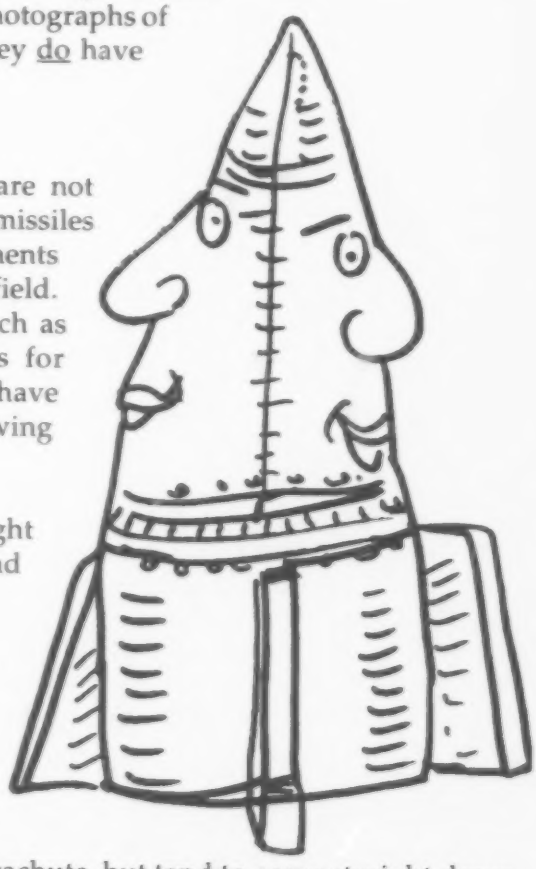
What do we need?



1. **Some type of propulsion system.**
Propellants come in two fundamental types. Solid propellants, which when ignited burn until the propellant is consumed and liquid propellants, which can be throttled (increased or decreased) or shut down and even restarted. Solid propellant rockets have been used for hundreds of years; long before liquid propellant rockets were perfected. Our rockets will use solid propellants.

In addition to the propulsion system one needs a mechanism for holding the rocket engine in place and allowing for the easy removal of the spent engines of recovered rockets. The model rockets use a flexible metal hook which holds the engine in place during thrust but can easily be pulled aside for removal of the spent engine.

2. **Some type of guidance system.**
NASA's rockets (launch vehicles) use highly sophisticated guidance systems which employ gyroscopes and small rocket thrusters. Sounding rockets which travel primarily in the Earth's atmosphere can rely successfully on aerodynamic fins for guidance and stability. Model rockets usually employ fins for stability and guidance. (You will note that the large NASA rockets have very tiny fins. Look at photographs of the Saturn V. Do not be mislead, they do have extensive guidance systems.)



3. **Recovery system.**
Some launch vehicles and rockets are not designed for recovery such as ballistic missiles (We won't make those!) or components which leave the Earth's gravitational field. (Ours won't go that far!) Others such as sounding rockets do have systems for recovery. Model rockets traditionally have employed one or more of the following systems.

Tumble recovery. Small lightweight rockets can actually free fall and land with minimal hazard.

Parachute. Most model rockets employ a parachute recovery to slow the descent for a safe landing.

Streamer. Streamers do not provide as slow a descent as a parachute, but tend to come straight down without being carried by the winds.

Other. These include various types of gliders and wing systems.

The most common type of model rocket engine has an ejection charge. After a short delay, a small charge blows forward, the hot gases blow the nose cone out carrying with it the parachute or streamer. Usually the body tube and nose cone are connected by a length of elastic called a shock cord. The parachute or streamer is protected from the hot gases by flameproof paper called "wadding." Other heat protective means can be used.

4. **Hold down system.**
   Why don't NASA's rockets fall over? They have a system of hold down arms to support the rocket on the pad. Model rockets use a launch rail and launch lug. The launch lug usually consists of a short section of soda straw attached to the body tube of the rocket.

5. **Payload**.
   The purpose of most launch vehicles is to haul some equipment to conduct experiments in the upper atmosphere or into space. For model rockets this can include cameras, temperature or pressure sensors, radio transmitters, etc.

The other factor which must be considered is the number of aerodynamic shapes possible. The forward end of the rocket contains the nose cone. Does it make much difference about the shape of the nose cone? This is the basis for interesting experiments. The size and shape of the fins is another topic for an interesting series of experiments. Must they be smooth? Does the leading edge need to be rounded, sharp or can it be flat? Does the trailing edge need to be sharp, rounded, tapered or can it be flat as well? How many fins? Three or four are common, but what about five or more? How about only two? These are just some of the questions that require research to answer.

Are we ready to commence designing a rocket? Almost! There are a few simple rules which will save some valuable time. For a rocket to be stable the fins must be on straight. Fins cocked at different angles will cause corkscrew and erratic flight. (If all of the fins are at the same angle the rocket will corkscrew in a helical motion. It may look pretty, but the rocket will not go as high.)

There are two important factors in the rocket design. **Center of Gravity** and **Center of Pressure**. The center of gravity is simply the point front-to-back where the masses are balanced. One could call it the balance point. It is easy to determine by placing the rocket (loaded with an engine and any payload) on the edge of a ruler. The center of gravity can be easily found. Another way is to tie a loop of string with a slipknot around the rocket and move the loop back and forth until it hangs level. That is a convenient way because the next step is to swing the rocket by the string in a large circle. If it moves in a smooth circle the rocket will be stable. If it wiggles or swings to one side, there are problems!

The center of pressure is difficult to compute because it takes into consideration the shape and size of the rocket as well as its varying cross section as it passes through the air. However, an easy trick to determine the center of pressure is to make an outline of the rocket—in a sense a footprint or silouette. Cut this shape out of cardboard.

Determine the center of gravity of this shape. That position on the actual rocket is the location of the center of pressure. For a rocket to be stable the center of pressure must be behind the center of gravity by about a distance equal to the diameter of the body tube.

With these factors in mind, go to it! Design your own rocket. Model rocket design can take the direction of scale models of actual launch vehicles, or fanciful and original design. Another idea is to fabricate model rockets out of available cast-off materials such as mailing tubes, potato snack cans, etc. Fins can be made from balsa sheets or sheets of styrofoam, etc. **The major consideration for model rocketry is to avoid metal pieces.**

DESIGNS OF MODEL ROCKETS

After the basic considerations of stability and recovery, there should be no limitation to your design.

1. Model rockets can be designed as accurate scale models of actual launch vehicles, sounding rockets and ballistic missles. The only major variation is that they will usually need additional fin area for stability. The commercial versions use clear plastic fins for this purpose.

2. Model rockets can be designed with any fanciful and/or futuristic design.

3. Model rockets can also be designed with a bit of whimsey. One famous model rocket was designed to look like the Washington Monument.*

   *This was designed and built by Mr. Kim Arnold, Planetarium Director and rocketry instructor, Kansas Cosmosphere and Space Center. This is just one of Mr. Arnold's many fanciful designs which include a styrofoam ball with sticks to simulate Sputnik. Others are made from cheese puff containers, potato chip cans and mailing tubes.

After the rocket has been built, it is important to finish it. Which will fly higher, an unpainted rocket or one which has a smooth glossy surface? The final appearance not only will affect the flight characteristics, but add a great deal of eye appeal. The choice is yours.

Use PLTS #7 in order to introduce the concept of thinking like an engineer.

BUILDING YOUR OWN LAUNCH SYSTEM

Be an Engineer: Take another look at things technical and think like an engineer.

How does an engineer think? **First**, state the problem to be solved. It may be necessary to break the original problem into tiny parts, i.e, the subsystems. Consider the purpose of each of the subsystems and how they interconnect. Question what each subsystem is to accomplish and determine the possible methods to accomplish that outcome. **Then,** determine which of these seems best for the situation. **Finally,** put them all together.

Use PLTS #4 in order to help identify students with high potential for generating and analyzing possibilities.

DESIGN AND CONSTRUCTION OF A MODEL ROCKET LAUNCHER

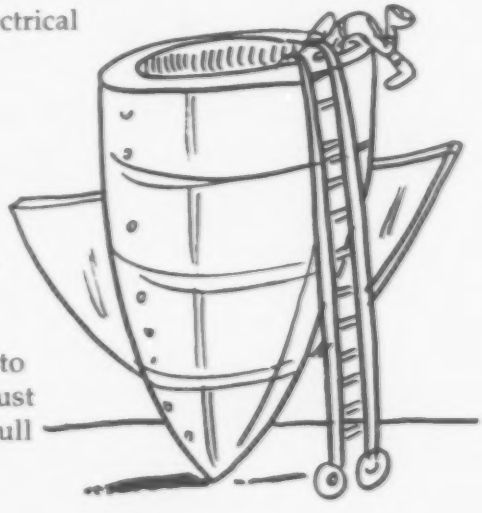
What is its purpose?

All that is necessary to launch the standard type of model rocket engine is to provide enough heat (from electricity or more accurately from electrical resistance) to ignite the material on the igniter wire, thus providing enough heat to ignite the propellant in the model rocket engine.

So, one could merely hook up a wire from one of the igniter leads to one terminal of a battery. Hook up another wire from the other igniter lead and as soon as the wire is touched to the other battery terminal Whoosh! Off goes the rocket! This isn't very fancy and it does not have any safety features. Perhaps this system can be improved.

Question: What is the best way of attaching the electrical leads to the igniter wires?

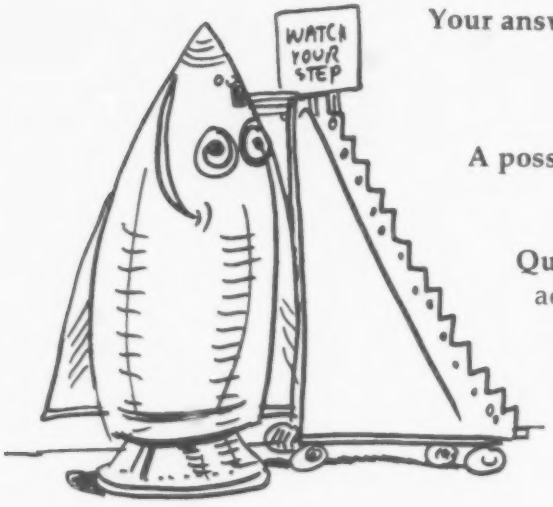
Your answer:



Other possible answers: Twist the wires together? -or- Tiny alligator clips?

Can you imagine how much trouble it would be to try to twist wires together? The alligator clips must be small, otherwise the weight would tend to pull the igniter wire out of the engine.

Question: How best to complete (close) the circuit when <u>you</u> want to launch?



Your answer:

A possible answer: Add a switch!

Question: What type of switch should be added?

Your answer:

Other possible answers: A knife switch (SPST) -or- A push-button switch?

If a knife switch is used, when contact is made the current continues to flow until the circuit is broken or the switch is opened. If a button switch is used, it is only on while the button is depressed. When pressure is released the spring opens the circuit. This system described above will work, but there is **no safety feature**. It is helpful to know that the rocket cannot be launched prematurely.

Question: How to avoid accidental premature launching?

Your answer:

Another possible answer: Add a safety key. This simply is a break in the circuit. The key when added completes the circuit. It need not be fancy or a real key, simply a conducting material that can be inserted to complete the circuit.

Question: How can one tell if there is a complete circuit (known as "continuity" in rocketry)?

Your answer:

Another possible answer: Add a meter or low resistance detector (a light bulb) which will serve as an indicator. The electricity will flow in <u>series</u> through the meter or bulb as well as pass through the high resistance wire of the igniter. There will be insufficient energy to heat the igniter. (This is the feature that requires studying electrical circuits.)

Question: How to attach the wires to a battery?

Your answer:

Another possible answer: Twist the wires on the terminals -or- use alligator clips or some kind of clip.

Of course this depends upon the type of battery used. Most of the Estes and Quest hand controllers use four AA batteries. This is fine for launching a few rockets, but there is a great deal of drain. One could use four D batteries, but it is simpler (and cheaper in the long run) to use a 6v lantern battery.

Question: How far should the launch controller (and you) be from the launch pad?

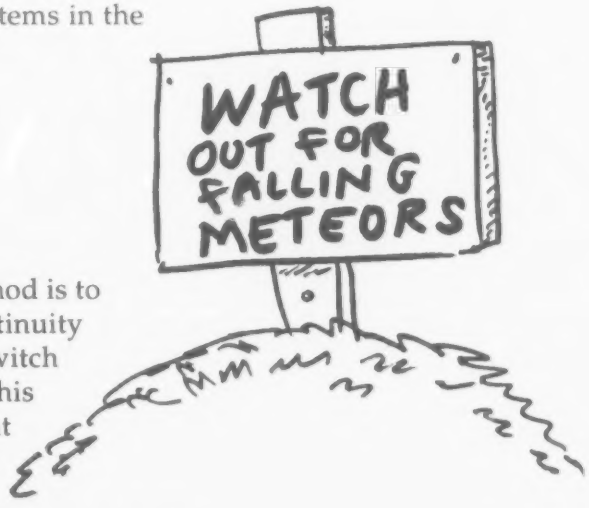
Your answer:

Another possible answer: For the Saturn V as well as the Space Shuttle, about 5.5 km is necessary, but for most model rockets 2 or 3 m is sufficient.

So let us review the parts necessary for a model rocket launcher.

1. a method of attaching electrical wires to the igniter wire
2. a method of attaching electrical wires to the battery.
3. a type of switch
4. a type of launch key (safety device)
5. a continuity detector
6. an actual electrical circuit

Question: Where to place each of these items in the circuit?



Your answer:

Another possible answer: A simple method is to place the battery, safety key, bulb (continuity detector) and igniter in series. Place the switch in <u>parallel</u> with the continuity bulb. In this way when the switch is pushed the current "takes the path of least resistance" and more electricity flows through the switch

and less through the bulb. You will notice for the commercial model rocket hand controllers that the lamp bulb goes out when the button is pushed. This provides sufficient current to heat the igniter sufficiently to ignite the engine.

Now you should be ready to design and build! You too can be an engineer (electrical, mechanical, construction, i.e., aerospace). To save expenses and time, the design engineer will prepare drawings and diagrams before fabricating any components. So, first prepare your design. You may wish to compare your design with your colleagues for competition of the best design. You need to compute the costs of the components as well as an estimate of fabrication time. In the real world of NASA, the contract usually goes to the lowest bidder!

BUILD YOUR OWN LAUNCH PAD

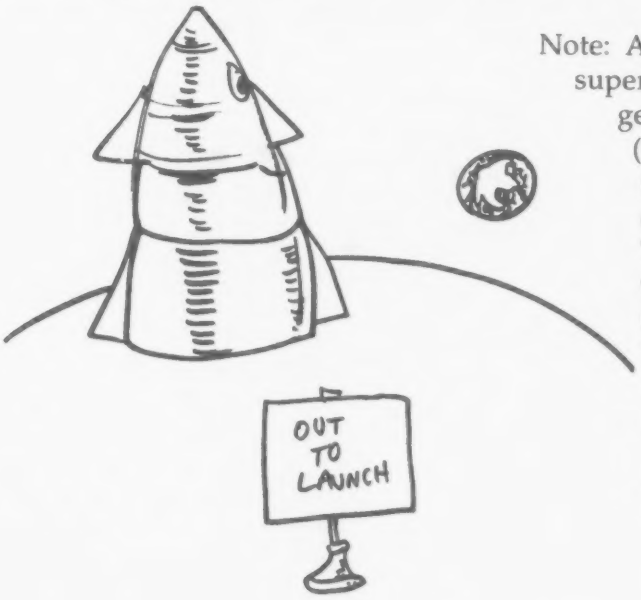
What is necessary? For model rockets, a launch rail is used to insure that the rocket starts off straight!

So all that is necessary is to obtain a section of straight wire about 3 to 5 mm in diameter. Can you find smooth welding rod? About one meter in length is sufficient.

This rod could simply be stuck in the ground, but...

There is a problem: To prevent burning grass or igniting asphalt, a blast deflector is a valuable addition.

A blast deflector can be made from a large can lid (a gallon can lid is excellent, but it can be smaller). **Be careful, the edge of a can lid is sharp.** The edge may be covered with adhesive or duct tape. A better solution is to cut the top (or bottom) out of the can with a can opener that cuts the side seam of the can. Merely punch a hole in the middle of the can lid to accommodate the launch rail.



Note: A can opener that cuts the side seam is superior because there is less chance of dirt getting into the contents of the can. (Have you ever taken a good look at the grunge on a can opener? How often do you clean your can opener?) The side seam openers come in two varieties. One type cuts the middle of the seam so that the lid can be placed back on the can. A neat idea! The other cuts below the seam which makes a good lid with no sharp edges for our purposes, but it leaves the edge of the can sharp. So be careful!

Problem: What about multiple launch pads? NASA only launches one at a time. With model rockets we can launch a succession of rockets.

Your solution:

Another possible solution: A board, perhaps a 2"x4" of sufficient length to accommodate several rockets, works quite well. Allow a reasonable distance between them (about 30 cm.) Drill holes to accommodate the launch rail.

Problem: How can one easily vary the launch angle? Sometimes it is better to launch into the wind rather than straight up.

Your solution:

Another possible solution: This can be accomplished by designing a lockable swivel. Whether you are constructing a single or multiple launch pad, one can design a system to vary the launch angle. This is where you can use your creativity!

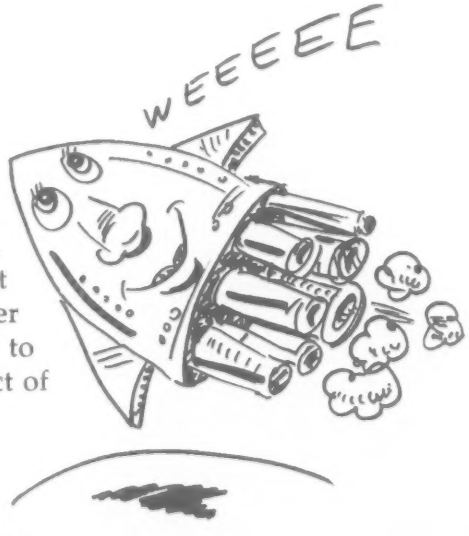
Problem: How can one avoid poking an eye out on the launch rail?

Your solution:

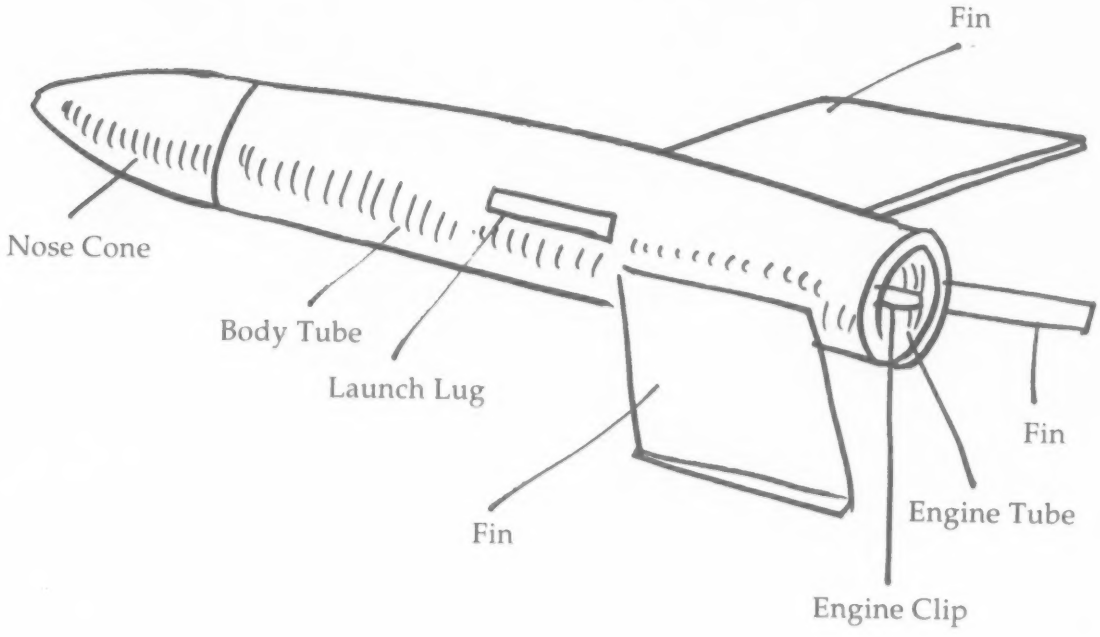
Another possible solution: One simple method is to place a highly visible cap over the end of the launch rail when it is not in use. Another method is to raise the height of the launch pad so that the top of the launch rail is higher than the heads of those using the launch pad. This can be accomplished by putting the launch pad on legs, such as a saw horse.

GO FOR LAUNCH

Now you have launch pads, a launch control system and rockets to launch. **What happens next?** The launch of course! For some rocket launches merely getting off the pad and into the lower atmosphere in a reasonably straight path is sufficient reward. But what about the question of "My rocket went higher (faster, further, straighter...) than yours..." ? How to measure the height of a model rocket is the subject of another topic.



After you have successfully launched rockets, are you satisfied? What changes have you thought about for improvement of the rockets, launch or recovery systems? It is back to the drawing board—but how many new and better ideas you have now! Remember that invention builds on prior technology. We don't invent out of thin air, rather we make incremental changes.



What about those for whom model rocket engines are too expensive (they do cost at least a dollar each) or the potential fire hazard (which is minimal)? There are the water rockets. This requires some different concepts. This is also the subject of another topic. (Wait for NITA-II!!!)

For further information about available materials and suggested activities. Write the following companies for their Technical Data Sheets, Educator News and a catalog.

Estes Industries, 1295 H Street, Penrose, CO 81240

Quest Aerospace Education, Inc. P.O. Box 42390, Phoenix, AZ 85080-2390

References:

Banks, M.A. & Cannon, R.L. (1985). *The Rocket Book.* Englewood Cliffs, NJ: Prentice Hall, Inv.

National Aeronautics and Space Administration. (1971). *Exploring in Aerospace Rocketry.* Washington DC: NASA.

Reinventing The Wheel

Barbara Van Wicklin
with
Dr. Michael J. Doyle

Barbara Van Wicklin

Mrs. Van Wicklin is co-author of Creativity and Innovation, a New York State Regents course and Project XL program. Mrs. Van Wicklin has given presentations on the subjects of creativity and gifted education at state, national and world conferences and to parent groups and schools throughout the country. Mrs. Van Wicklin is currently a curriculum/staff specialist for the Allegany/Cattaraugus Board of Cooperative Educational Services in Western New York. She is a member of the Commissioner of Patents and Trademarks Roundtable, Project XL and a charter member of National Inventive Thinking Association. She also serves on Congressman Amory Houghton's Educational Advisory Board, the New York State AGATE (Advocacy for Gifted and Talented Education) Board of Directors and is Vice-President of the Allegany County Arts Association.

Dr. Michael J. Doyle

Dr. Doyle, co-author of Creativity and Innovation, is presently the Program Director of Technology at the National Technology Transfer Center located at Wheeling Jesuit College, Wheeling, West Virginia. Dr. Doyle has experience as a high school technology teacher and received Western New York State's Technology Teacher of the Year award for his innovative teaching practices. He has written many curriculum projects for the New York State Education Department and was a team leader for the change from industrial arts education to technology education throughout the State. He is facilities editor for TIES magazine. Dr. Doyle is a well known presenter on the subjects of creativity, technology and gifted education. He has presented at many state, national and world conferences. He is a member of the Commissioner of Patents and Trademarks Roundtable, Project XL and a charter member of National Inventive Thinking Association.

REINVENTING THE WHEEL

"Two men look out the same bars, one sees mud and one sees stars."
Frederick Langbridge

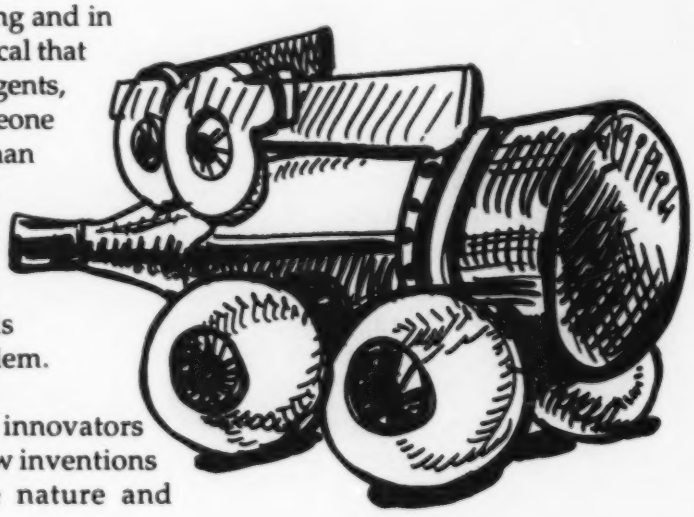
Barbara Van Wicklin with Dr. Michael J. Doyle

In order to strengthen our awareness of details in the environment, we must first heighten our perception of it. Since much of what we sense is processed visually, drawing is one of the key factors in heightening our perception of detail. The purpose of drawing in this section is not for art's sake, but to record, communicate and formulate ideas and images. Drawing is a fundamental skill for the solution of technical problems.

In this section, students also will explore introductory problem solving skills and develop a sensitivity for conditions in need of change. To begin this process of improving or changing, it is necessary to shake up students' thinking, heighten conflict awareness and make new connections in the mind's eye. Opportunities abound for those who can perceive them. The first wheel made of rock was a wonderful idea. Fortunately, someone had the perception to see the function of shape and the potential of rubber, steel, metal and fiberglass in connection to the original idea.

In the American high school today, most students believe what is... is good enough. School itself has remained basically the same in a world which is changing from moment to moment. It is hard for students to understand the process of change unless they become involved in the process.

Why change things that are working and in some cases working well? It is critical that students see themselves as change agents, or the future will belong to someone else. Much of the impetus for human progress and technological growth is the realization that things can be improved. When we sense that something needs to be changed, a basic step has been taken towards the indentification of the real problem.



The study of the creative efforts of innovators and inventors and the need for new inventions helps develop insight into the nature and

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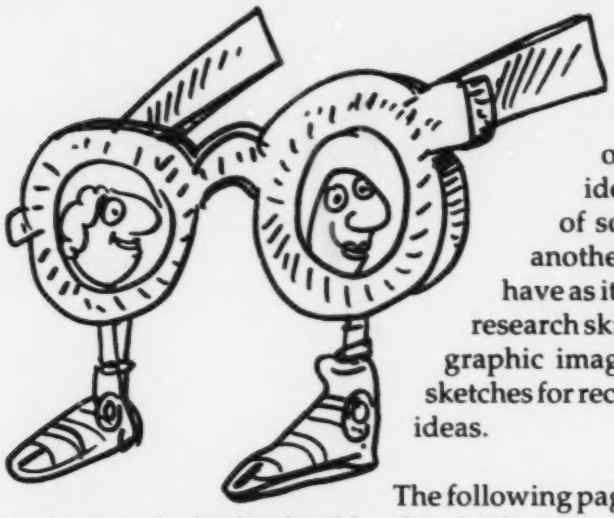
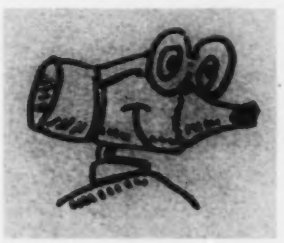
characteristics of innovators and inventors. It also imparts an understanding of the impact of their work on mankind.

This section has a dual focus: 1) sensing problems and challenges 2) an introduction to applied visual techniques. The outcomes of the first focus will be the student's ability to: identify wants, needs and values; the ability to use deferred judgment; identify convergent and divergent thinking; identify problems and challenges in need of solution; identify opportunities for development and identify problems and challenges in need of solutions by being able to identify with another point of view. The second focus will have as its outcome the student's ability to utilize research skills, draw sketches for recording realistic graphic images in pictorial drawing and produce sketches for recording, communicating and formulating ideas.



The following pages contain activities that will encourage students at the high school level to think creatively. They are springboard activities that teachers can use to spark other ways for students to become inventive thinkers. The performance is the goal statement. The instructional strategy is the activity that the teacher uses to teach to the goal.



Use PLTS #2 with this activity in order to help identify students who observe skillfully and deeply.

Performance: Students will be able to identify with another point of view.

Instructional Strategy I:

1. Students will brainstorm and list problems from their own life experiences. Have students identify, by sketching and/or describing, things that need improvement. Use a positive focus as opposed to finding fault.

2. Brainstorm and list problems, through sketching and/or describing, that could be generated through the following themes:

   waste, bottlenecks, school, home, homework, anxieties, misunderstanding, transportation, communication, leisure, plans and goals, pet peeves, comfort, help for those with handicapping conditions, improvements, eating, safety, shelter

AND

3. Brainstorm and list problems, through sketching and describing, from the point of view of the following:

   a 3 year old, a 5 year old, a 1 year old, a 45 year old, a 75 year old, a foot tall adult, an animal such as a dog or cat, a blind person, a deaf person, a mute person, a 150 lb. overweight person, a teacher, a doctor, a member of the clergy, a store owner, a fast food restaurant manager, a politician

AND

4. Using examples from strategies #1, 2 and 3, list, through sketching and describing, problems that might be seen through a combination of examples from each list. For example, pet peeves of a blind adult or transportation for a doctor.

Instructional Strategy II:

Students will design a product/invention which can be used by the combination of #1, 2 and 3.

THEN:

Students will role play the situation which arises from the combination of #1, 2 and 3 before the invention was created and after the invention. (This can be in the form of a TV advertisement, etc.)

SENSING PROBLEMS AND CHALLENGES INNOVATORS AND INVENTIONS

Problem solving systems are plentiful. A process whereby Creative Problem Solving (CPS) and Technical Problem Solving are combined to formulate new and creative ideas is called "Envisioneering." While envisioneering, not only does a student look for solutions through CPS, he combines the CPS steps with those of technical problem solving, which include sketching and modeling.

In order to create an invention to solve a problem, there must first be an awareness of a problem. In school, students solve contrived problems that already have answers. Real world problems are all around them, yet they are unsure of how to define them. In inventive problem solving it is sometimes possible to have an answer without knowing the question.

The following chart shows the differences between contrived problems — those that are usually teacher made with right or wrong answers and real life problems—those that depend largely on the relevance of the problem for the students and the process by which they define, redefine and accept them. Contrived problems are low risk and a teacher can teach how to find the correct answers. There is little chance of failure in that the answer can be found if the steps are followed. Students often have difficulty with ownership of these problems. Real world problems on the other hand, are those without a preconceived answer.

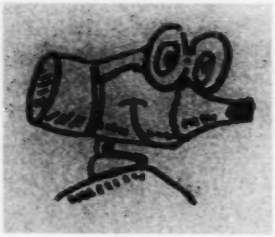
All students will come up with unique responses. They are high risk problems because they take personal creativity and the answers must be found through a student's personal investigation. There is a high risk of failure. Odyssey of the Mind (OM) problems are examples of high risk problems. Students will take ownership of real world problems because they choose what they want to solve. Students who own the problem have a sense of purpose and a focus for their actions. If students do not acquire some ownership of the problem, their attempts at developing solutions will likely be disjointed and ineffective.

THE PROBLEMS	
CONTRIVED PROBLEMS	**REAL WORLD PROBLEMS**
Simplified artificial tasks	Complex, unclarified real world tasks
Highly Structured Problems	Ill-Structured Problems
Artificial Constraints	Real constraints > Aesthetics > Cost > Durability > Environmental impacts > Produceability > Serviceability
Limited technical criteria	Multiple "Real World" criteria
Simple resources	Balanced technological resources

(taken from the New York State Education Department's course "Creativity and Innovation")

DEMANDS ON STUDENTS	
CONTRIVED PROBLEMS	**REAL WORLD PROBLEMS**
Simple, naive, limited, common demands	Complex knowledgeable, diverse, technological demands
Undemanding Tasks - quick, easy, low risk of failing	Demanding Tasks - extended, complex, moderate to high-risk of failing
Limited potential for divergent or critical thinking	Rich potential for divergent and critical thinking
Knowledge source is from within the student	Extends the students technological knowledge

(taken from the New York State Education Department's course "Creativity and Innovation")

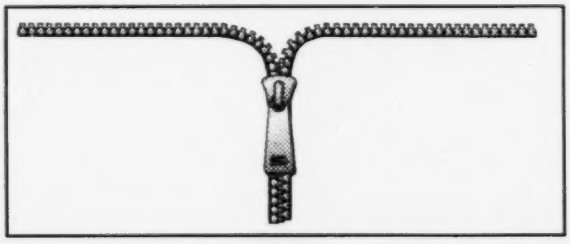


Use PLTS #3 with this activity in order to help identify students who acquire and use much information creatively.

INVENTORS AND INVENTIVE THINKING

Performance: Students will research an invention or inventor and make a presentation to the class.

Instructional Strategy:



1. Students will choose something in the real world and research the object. WHO invented it? WHEN was it invented? HOW was it invented? WHY was it invented? The student will create a timeline of their own choice. If a historical timeline is of interest, the student will choose some aspect of the invention—be it material, function or application for the product. What was happening in the world to necessitate the product's invention? Was the material used because a better product had not been invented or did the product spring off another invention? The goal for the student is to choose inventors and inventions unique and unfamiliar to them. The goal for the student is to expand knowledge rather than give feedback.

2. Make an invention web. Discuss all the different connections that the inventor had to make in order to design his new creation. What ideas or objects did Gutenberg have to combine in order to make a printing press? What did the inventor of velcro connect in order to come up with his invention? Look for other interesting stories. Have students search for commonalities in inventor's designs. How many used objects in nature as a starting point—Wright Brothers/birds; the inventor of Velcro/dogs and burrs etc.

   (Optional activity) If the inventor is still alive, research where to contact. Then write, fax or call the person for an interview or for the answer to at least one question.

REDESIGNING AND IMPROVING A PRODUCT

Performance: Students will go through the process of improving and/or redesigning an object.

1. Students will choose one place to sit (in school) and observe for three 1/2 hour periods. During this time they will record data regarding a specific problem area in their school: the school cafeteria line, the school parking lot, a particular stairwell in the hall, etc. Then they will interview and record other student's perceptions of the problems cited. After a review of the data, they will go to the drawing board and design, or redesign, a solution to the problem.

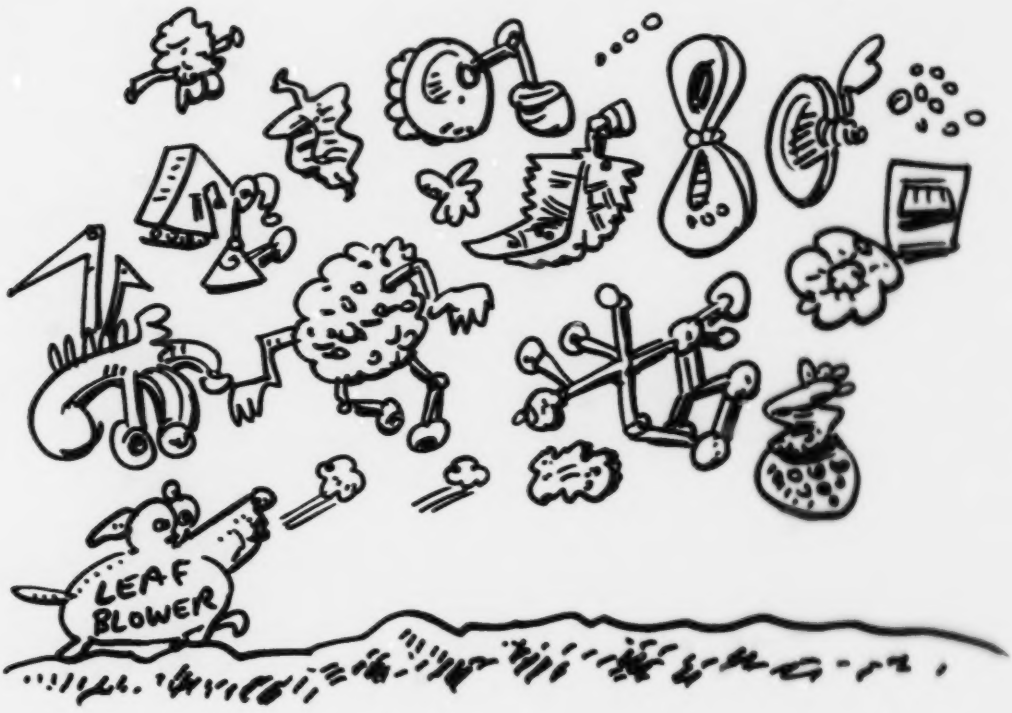
2. The student will design and produce one of the following:
   - a personal logo or flag
   - a flag for the combined countries of the United States, Mexico and Canada (choose any three countries)
   - a record album cover
   - a new yearbook cover or school logo
   - a poster to transmit a message without using words
   - a new currency (paper or coin)

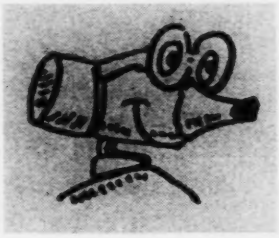
   This activitiy encourages students to make observations, ask questions and make note of things that are in harmony or discord.

3. Design a leaf for a plant from another planet. The student will choose a planet, either real or imaginary, and design a leaf from a plant or tree on that planet. The student will need to research the atmosphere, water supply, amount of sunlight and life forms of the planet and make the plant adaptable to that atmosphere. Who needs the plant? What does it take to survive? Where does it flourish? How is it used by the planet's inhabitants? What other ways can it be used? How is it recyclable?

   Construction of the leaf must be of materials which would be suitable for existence on the real or imaginary planet. An environment to stimulate student creativity should be established. However, the student must be able to explain

his choice of material in light of what he knows about the conditions of the planet. This activity involves the student in seeking information, collecting, organizing and analyzing data, experimenting with materials and engaging in design, drawing, modeling and prototyping.





Use PLTS #1 with this activity in order to teach about evaluation.

4. Ketchup package activity. The following activity is presented in lesson plan form. An assestment tool in rubric form is included. It may be given to students prior to the activity. Students will see what is appropriate at each particular level of achievement. The rubric will then be used as the measurement device to see what level actually was achieved.

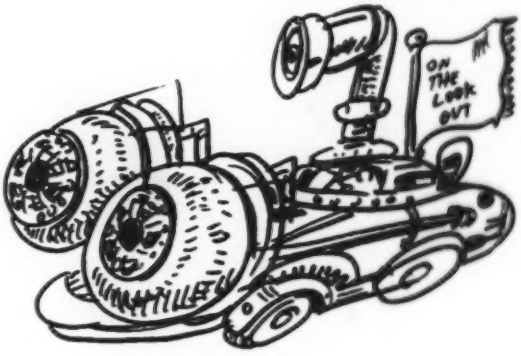
The rubric has been adapted from one developed by Andy Rudd and Geoffrey Hicks, Wellsville, NY.

Sample Lesson Plan:
Redesigning an existing product.

Activity: The student will redesign a pre-made ketchup packet.

Standards: Student will be able to think through ways to make an existing product better. Student will be able to communicate through sketching and drawing. Student will show evidence of his/her creative thinking process through a log.

Materials needed: ketchup packets
sketch paper
pencils



Procedure:

1. Hand out the packets of ketchup. Tape two fingers together on the hand of every fourth student. (This will enable students to solve the problem from the point of view of a handicapped person.)

2. Discussion: Why were these packets designed the way they are? What factors, both environmentally and ergonomically, were considered?

3. Does the design work? Why or why not? (Students will record their thoughts through sketching or writing in a log.)

   a. Have them open one without using their teeth. WHY?

   b. Brainstorm what is good about the design and what is lacking.

   c. Have students work in design teams. Each student should think about the best and worst ideas of the present design. After teams discuss their thoughts, each team member should sketch various ways the product could be redesigned. A student might find that the packet is OK but the ketchup should be redesigned—perhaps a gelatin or paste. Be flexible in looking for solutions so that other ideas or concepts might come forward.

   d. Have the team discuss the various drawings. Choose one or a combination of many to redesign the product.

Extended research idea: Have students watch other students in the cafeteria for one or two lunch periods. Record data as to the various ways students open and use the packets.

RUBRIC FOR INVENTION TASKS

Score	Criteria
Subcompetency A:	***To what extent would the invention proposed by the student improve upon the identified object?***
Level 4	The proposed invention provides a unique solution to the situation. The proposed invention reflects a high level of creative thinking.
Level 3	The stated purpose provides a good answer to the identified situation.
Level 2	The proposed invention will not provide a complete remedy for the need.
Level 1	The proposed invention has little or no relation to the unmet need or situation described.
Subcompetency B:	***How rigorous and important were the identified standards or criteria the final invention should meet?***
Level 4	The student sets out rigorous criteria well suited to the purpose of the invention. The student identifies only the highest achievable standards of quality as the acceptable outcome of his product.
Level 3	The student establishes an appropriate set of criteria for the invention.
Level 2	The student identifies criteria for the invention that may not be completely appropriate to the product. The student sets standards for completion that do not ensure a worthwhile or completed product.
Level 1	The student establishes criteria that fail to address the most important purposes for which the invention will be made. Standards are set so low that little quality can be expected.
Subcompetency C:	***How detailed and important were the revisions the student made on his initial model or draft?***
Level 4	The student reviews the draft or model at a considerable level of detail. The revisions or improvements clearly bring the product closer to fulfilling the purpose for which it is designed. The student's attention to the details of the draft or model makes a high quality product likely.
Level 3	The student revises the draft or model in such a way that the purpose of the product is served.
Level 2	The student revises the draft or model but attempts to address only the most obvious difficulties.
Level 1	The student makes few, if any, attempts at correction and appears satisfied with the initial draft or model although obvious difficulties remain.
Subcompetency D:	***To what extent did the final product meet the standards and criteria that had been identified?***
Level 4	The student develops a final product that meets the criteria established at a demanding level of quality. The product fulfills the purpose for which it was designed. In addition, the product reflects creativity and establishes a model for creative work of high quality.
Level 3	The student continues the revision process until the product meets the standards and all criteria. The product successfully serves the purpose for which it was designed.
Level 2	The student revises the product until it meets minimum standards.
Level 1	The student ends the process before the product has met minimum standards. The student's product does not meet many important criteria and fails in its purpose.

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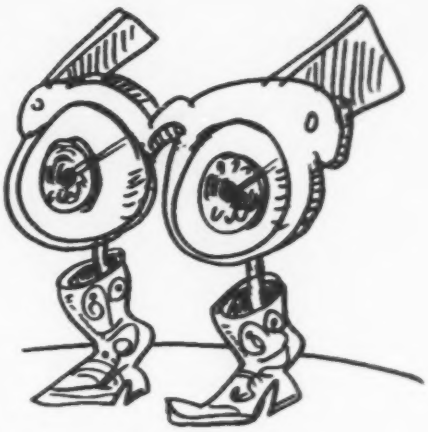
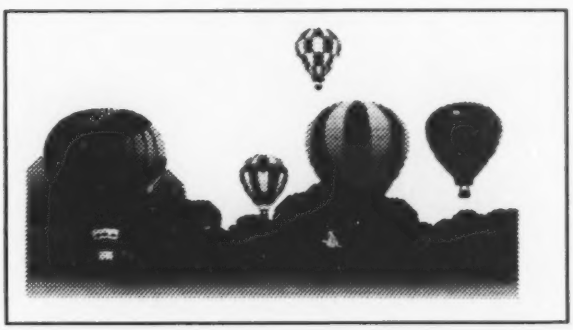
DRAWING AS A MEANS OF COMMUNICATING



The written word is taught throughout a child's school career. We learn to communicate through reading and writing. However, our minds talk to us in pictures. We learn to think through seeing things and making connections. Sketching is a way of communicating that which we see and understand. It has been said that a picture is worth a thousand words and a model is worth a million. Students need to learn to record their thoughts and progress through sketching. Leonardo Da Vinci used drawing as a means of communicating when words failed. Sometimes the process of seeing objects come together in our mind's eye is as valuable as reproducing them with a paper and pencil. It is important to give students activities that use shapes in design problems.

Performance: The student will design a structure—be it imaginary or realistic—using geometric shapes.

Teaching Strategy: The student will learn to draw the basic geometric shapes. Some examples of realistic sketching would be: cylinder forms such as pots, pans, cans, glasses, jugs and pill bottles or cube forms such as boxes, books, buildings, tables, chairs and toasters or cone forms such as wood screws and nails or spherical shapes such as apples, oranges and balls or pointed structures such as wood screws, nails and steeples. Most things can be sketched by using the basic geometric shapes. Students should learn to sketch quickly. Drawing must be used as a tool and not an art form.



Some examples of structures to make would be: imaginary animals, newly designed aircraft, etc.

Students will then be able to combine various shapes to create a new machine, toy and/or storyboard for a short story they have written.

The construction of tanagrams and participation in tanagram puzzle problems serves the purpose of having students use shapes in the formation of a completed project. It will train them to think in terms of geometric drawings and structures. It helps make the shift from 2D drawing to 3D modeling.

Materials needed: *Tanagrams: 334 Puzzles* by R. Read

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